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AIRLINE DELAY TRENDS 1972 - 1977.(U)

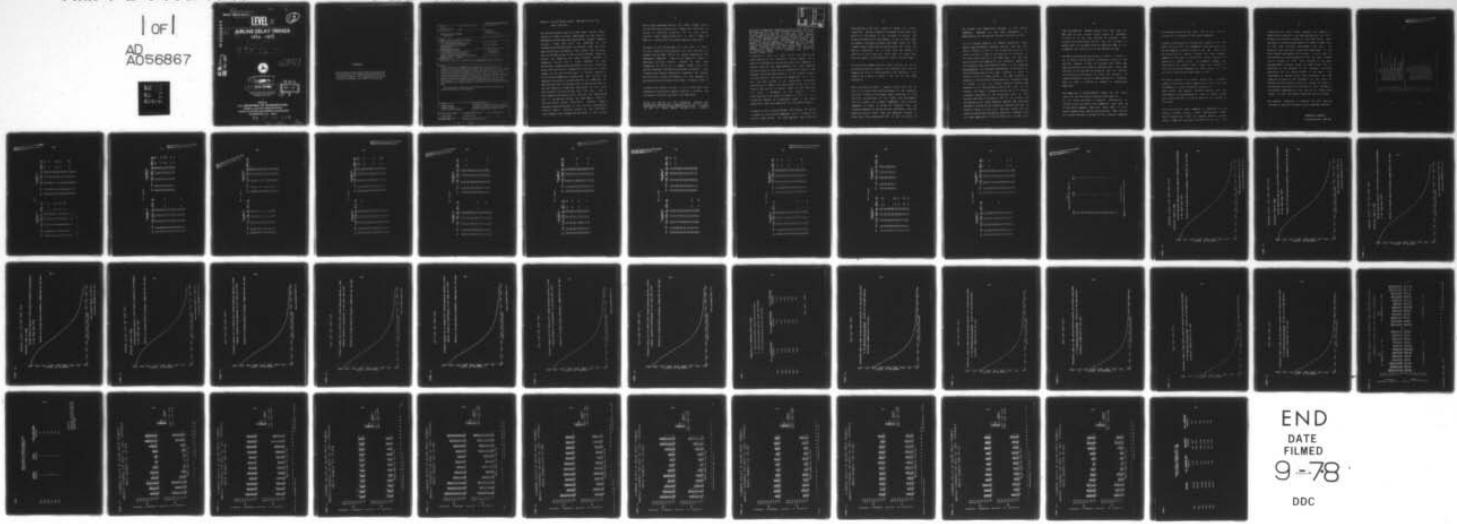
JUL 78 S MORIN, S M HOROWITZ

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AIRLINE DELAY TRENDS 1972 - 1977.

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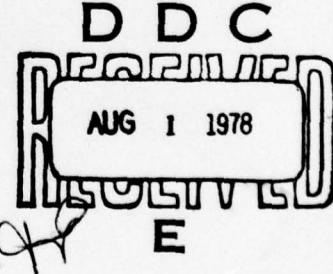


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11 Jul 1978

9 FINAL REPORT

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Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
OFFICE OF SYSTEMS ENGINEERING MANAGEMENT
WASHINGTON, D.C. 20591

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Technical Report Documentation Page

1. Report No. FAA-EM-78-11	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle AIRLINE DELAY TRENDS 1972-1977		5. Report Date July 1978	
7. Author(s) Stephen Morin, Seymour M. Horowitz		6. Performing Organization Code	
9. Performing Organization Name and Address U. S. Department of Transportation Transportation Systems Center Kendall Square Cambridge, MA 02142		8. Performing Organization Report No.	
12. Sponsoring Agency Name and Address U. S. Department of Transportation Federal Aviation Administration Office of Systems Engineering Management Washington, D. C. 20591		10. Work Unit No. (TRACI) 11. Contract or Grant No.	
15. Supplementary Notes Reference: Report No. FAA-EM-74-11, Airline Delay Trends, 1972-1973		13. Type of Report and Period Covered Final Report 1972 thru 1977	
16. Abstract <i>This document is an updated edition (data for the years 1976-1977 are included) of the Annual Airline Delay Trends Report published since 1974. These reports provide estimates of block, airborne, and ground delays for approximately 325 route segments connecting 20 of the most active U. S. airports, and serviced by the domestic scheduled air carriers. Delay information as presented in this summary edition consists of airborne and ground data for each of the 20 airports in the study, displayed in both table and graph form, for the years 1972 through 1977. This information was obtained from the Civil Aeronautics Board ER-586 Service Segment data in combination with other airline operational data.</i>			
With this report, a new format is introduced for presenting comparative estimates of trends in airline delays.			
17. Key Words Traffic Activity Airborne Delays Ground Times and Delays		18. Distribution Statement <i>Document is available to the U. S. public through the National Technical Information Service, Springfield, Virginia 22161</i>	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages	22. Price

Subject: Airline Delay Trends; CAB Data File for the
years 1976-1977

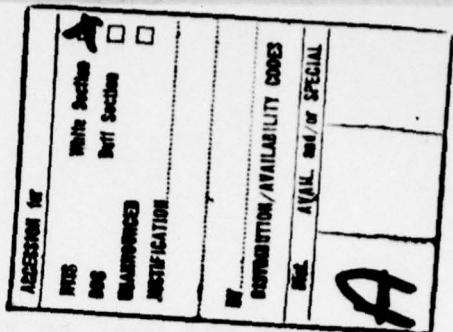
For the past several years, we have been issuing annual reports of trends in delays experienced by the nation's scheduled airlines operating from the 20 largest domestic airports. These data which are processed by the Transportation System Center, are derived from the block operational-time information, both ground and airborne, sent to the CAB as part of the airline's monthly reporting system. By comparing the times actually recorded in commercial service with a fixed standard of good performance, comprehensive estimates of airline block-time delays were derived and categorized according to flight number, airline and aircraft type. A further separation of the ground component of delays into their arrival and departure directions, was made possible by combining the CAB data base with the ground time information provided by the Port Authority of New York, New Jersey for the three major airports serving the New York City area. (For a more complete description of the data and the methodology used in estimating delays, see FAA Report EM-74-11, "Airline Delay Trends, 1972-1973"). Previous reports presented these delay data in all of this considerable level of detail: Airborne delays for 325 individuals route segments were categorized according to the airline

and aircraft equipment serving the route; ground delays for 20 individual airports were categorized according to arrival or departure direction, and by the hourly interval, "busy" (0700 to 2259 hrs.) or "dull" (2300 to 0659 hrs.) during which the ground operation took place.

The data are still being compiled in this level of detail for use in specific study projects, and are available on request from the FAA, Office of System Engineering and Management, (AEM-100). They will no longer be issued in published versions, however. Instead, we have been attempting to arrive at a summary format which will provide highlight information concerning the general trend in operational delays encountered throughout the system. We think that a format satisfactory for this purpose is provided by the percentage array shown in figures 1 thru 3.

To begin with, tables 1.1a and 1.b, (p. 9) which have been reproduced from previous reports, provide a listing of the airlines and airports included in the data base.

Delays are defined as the difference between the operational times actually experienced by the airlines, recorded by the CAB, and the nominal time shown in tables 1.2 and 1.3. These nominal standards were actually



achieved in commercial operation during a given month in the index year of 1972. The standards times and the month in which they were observed to occur, are shown for the airborne portion of the trip, by individual route segment (e.g. "7209" indicates that the best operational time was achieved in September 1972). Several route segments may be involved in a single cross-country trip, but each segment is reported separately. By comparing the segment time actually experienced during a given month with the nominal standard that has been established for this segment, an estimate of delay is defined. In attempting to establish trends, it is necessary only that the standard remain fixed.

In figures 1.3 thru 1.7, (pps. 21-25) the operational times experienced for individual flight numbers for a month of scheduled airline services have been compared to standard times for the approximately 325 route segments that were actually flown out of a theoretical limit of 380 segments resulting from a maxtrix of 20 airport origins and destinations. The delays were summarized for a full year and then arrayed in an accumulated percentage distribution of numbers of flights whose delays were less than or equal to the "n" minutes shown on the abscissa; "n" being a parameter of the analysis. This distributional array shown in figures 1.3 thru 1.7 is a convenient method for displaying trends in the total operational time performance for the 20 airport network.

A similar array of the percentage distribution of delays is shown for the airborne component only in figures 2.3 thru 2.7 (pps. 26-30). By superimposing these profiles

from one year to the next, trends in delays are readily identified. The more "bowed" or extended to the right the profile is, the greater is the increase in delays. By using these profiles in this manner, it can be seen that no dramatic increases in delays have taken place for the airport network described during the years for which the data are available. It is clear that the shifts in profiles for the 5 years for which data are shown have been very small; all profiles fall within a narrow range.

It facilitates comparisions in these profiles to select any given precentile shown on the ordinate axis and to compare the trend in delays shown on the abscissa. This comparision is shown in table 2 (p. 31) for the 50th percentile:

Note that there has been a "mixed" trend from 1973 to 1977 in the total block time performance of the scheduled airlines, (column A.) with peak years occurring in 1974 and 1977. A break-down of this block time performance into its ground and airborne components (the airborne component is shown in column B) indicates that the airborne component of delays has been decreasing from the peak year shown in 1974. Thus, the observed increase in total block times observed in 1977 is due to delays on

the ground; the system-wide increase in the ground component, measured at the 50th percentile, is approximately 0.5 minutes for the year from 1976 to 1977.

It is, of course, possible to compare operational times against any performance standard, and not just the ones shown in tables 1.2 and 1.3. As an analytical exercise in order to provide a frame of reference for the dimension of the delay being reported in this FAA study, the CAB data were processed and compared to the standards imposed by the scheduled times published each month in the Official Airline Guide. The cumulative percentage distribution of delays measured against this, OAG, standard is shown in figures 3.3 thru 3.7 (pps. 32-36). The OAG standard is observed to be much more lenient than the standards shown in tables 1.2 and 1.3: Delays measured against OAG schedules at the 50th percentile are on the order of 2-3 minutes, (see table 2, Column C) and not the 12-13 minutes estimated according to the definition used in this analysis and shown in Column A; 33% of the flights are not delayed at all when measured against OAG published standards, and 85% of the flights are delayed less than 10 minutes (figures 3.3 thru 3.7). The main reason why the delay estimates measured against published schedules show very good compliance is that the delays are already built

into the schedules. Another reason is the fact that the CAB data do not include delays caused by equipment failures or by the late boarding of aircraft. They include only those delays incurred once the aircraft is moving under its own power from the departure ramp to its subsequent full stop arrival at the destination ramp.

The OAG-standard delay data shown in table 2, Column C, (p. 31) show a similar pattern of peak-year delays in 1974 and 1977. However, it must be stressed that these OAG data are provided as a frame of reference only, since OAG schedules do not satisfy the condition that the standard for defining airline delays be fixed and constant. As stated previously, changes in OAG schedules are frequently made in order to conform to changes in operational experience.

The comparison in average monthly delays for the latest years 1976 and 1977 can be observed from figure 4.1, (p. 37) which provides a graphical presentation of airborne and ground delays for a composite route made up of the top 50 segments. Note that these data, in their annual summary form, confirm the previously noted pattern of a slight decrease in delays for the airborne component

of blocktime delays for the year 1976 to 1977, and an increase of 0.5 minutes for the ground component.

A tabular presentation of similar data, summarized for the years 1972 thru 1977, for a composite route made up of the top 50 segments is shown in table 3 (p. 38). Note that the delays for this smaller network (50 route segments compared to the total of 325 actually flown) confirm the pattern of a "mixed" trend: no dramatic changes have taken place; the highest block delays were reached in 1974, but the ground component of these delays for 1976 and 1977 already exceed those shown in 1974.

The monthly pattern of airborne delays for a selected number of individual routes comprising the list of the top 50 segments, is shown in figures 4.2 thru 4.11 (pps. 39-48). The nominal standards against which the performance is being measured in order to define delays were taken from table 1.2 and are shown on the bottom of the figure.

The list of top 50 route segments is dominated by the nation's busiest airport, O'Hare International (ORD). Table 4 depicts the trend for average monthly airborne delays at ORD, for the years 1972 thru 1977 (p. 49). The

flight activity levels shown represent the numbers of observations contained in the CAB data base for the 20 x 20 matrix of airports included in this FAA study. Note the familiar airborne delay pattern for ORD of a peak year in 1974, with continued improvement since then. In addition, there has been a significant improvement in the "worst month" performance for the year; a worst peak of 0:24 minutes of airborne delays in 1974 has been reduced to 0:17 minutes in 1977. This lowering in the peak average monthly airborne delays at ORD during 1977 is confirmed by the measure of the standard deviation calculated for the twelve months of the year. The improvement in making delays more consistent and less dispersed is shown by the estimates for the values of standard deviation shown in the last column of table 4. The standard deviation of 2.8 minutes in 1977 reflects a considerable improvement in the ability to reduce peak delays. In 1972, the standard deviation was 4.2 minutes.

Any comments, questions or requests for more detailed information should be directed to me at AEM-100, 426-9553.

SEYMOUR M. HOROWITZ

Program Manager, AEM-100

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TABLE I-1 MAJOR AIRPORTS AND AIR CARRIERS INCLUDED IN STUDY

AIRPORT CODE	AIRPORT NAME
1. ATL	William B. Hartsfield Atlanta International
2. BOS	Boston Logan
3. CLT	Cleveland - Hopkins International
4. DFW	Dallas/Fort Worth
5. DCA	Washington National
6. DEN	Denver - Stapleton International
7. DTW	Detroit Metro
8. EWR	Newark (New Jersey)
9. JFK	John F. Kennedy International (New York City)
10. LAX	Los Angeles International
11. LGA	La Guardia (New York City)
12. MIA	Miami International
13. MSP	Minneapolis/St. Paul International
14. MSY	New Orleans International (Moisant)
15. ORD	O'Hare (Chicago)
16. PHL	Philadelphia International
17. PIT	Greater Pittsburgh
18. SEA	Seattle/Tacoma International
19. SFO	San Francisco International
20. STL	Lambert - St. Louis International

a / Annual reports for the years 1972-1973 include data for DAL, Baja-Jalisco Field

AIRLINE CODE	AIRLINE NAME
1. AL	Allegheny Airlines, Inc.
2. AA	American Airlines, Inc.
3. BN	Branson Airways, Inc.
4. CO	Continental Air Lines, Inc.
5. DL	Belta Air Lines, Inc.
6. FA	Eastern Air Lines, Inc.
7. FL	Frontier Airlines, Inc.
8. RW	Air West, Inc. - (Hughes)
9. SH	Nohawk Airlines, Inc.
10. VA	National Airlines, Inc.
11. NC	North Central Airlines, Inc.
12. VY	Northeast Airlines, Inc.
13. NW	Northwest Airlines, Inc.
14. OY	Ozark Air Lines, Inc.
15. PA	Pan American World Airways, Inc.
16. PI	Piedmont Aviation, Inc.
17. SO	Southern Airways, Inc.
18. TT	Texas International Airways, Inc.
19. TW	Trans World Airlines, Inc.
20. UA	United Air Lines, Inc.
21. WA	Western Airlines, Inc.

A.

B.

b / Data for specific airlines do not appear in this summary volume. Please refer to reports for individual years for this information.

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TABLE I-2
NOMINAL AIRBORNE TIMES*
DEPARTING BOS

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME YR/MO	NOMINAL DATE YR/MO	NOMINAL PROP TIME YR/MO	ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME YR/MO	NOMINAL DATE YR/MO	
ATL	BOS	345	1:50	7201		BOS	ATL	546	2:07	7208	3:35
ATL	CLE	554	1:13	7201		BOS	CLE	563	1:19	7205	
ATL	DAL	721	1:29	7205	2:36	BOS	GIA	1551	3:23	7209	
ATL	DCA	547	1:07	7212		BOS	DCA	399	0:59	7210	1:30
ATL	DFW	731	1:35	7404		BOS	DEN	1766	3:57	7208	
ATL	DTW	595	1:16	7205		BOS	DFW	1561	3:35	7407	
ATL	JFK	745	1:27	7212	2:10	BOS	DTW	632	1:59	7205	
ATL	JF	760	1:26	7207	2:46	BOS	ELM	231	0:40	7210	0:40
ATL	LAX	1946	3:36	7204		BOS	JFK	187	0:29	7203	0:56
ATL	LGA	761	1:31	7212	2:10	BOS	LAX	2611	5:36	7206	
ATL	MIA	595	1:15	7209	1:59	BOS	LGA	145	0:35	7211	0:38
ATL	MSP	906	1:59	7207		BOS	MIA	1253	2:32	7202	
ATL	MSY	425	0:57	7203	1:34	BOS	MSP	1124	2:40	7205	
ATL	ORU	606	1:15	7204	2:19	BOS	MSY	1367	2:59	7209	
ATL	PHL	666	1:17	7212		BOS	ORU	367	1:48	7211	
ATL	PTT	575	1:16	7205		BOS	PHL	280	0:42	7210	1:24
ATL	STL	413	2:37	7207	4:26	BOS	PIT	496	1:15	7204	2:32
ATL	SLC	484	1:06	7207		BOS	SEA	2496	5:46	7208	
						BOS	SLC	2704	5:43	7205	
						SOS	SLC	1346	2:21	7206	

*Airborne Times (minutes) refer to minutes of

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TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES DEPARTING CLE				NOMINAL AIRBORNE TIMES DEPARTING DCA			
ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO	NOMINAL PROP TIME
CLE	ATL	554	1:19	7202		DCA	ATL
CLE	BOS	563	1:04	7204		DCA	BOS
CLE	DAL	1015	2:08	7206		DCA	CLE
CLE	DCA	310	0:47	7201		DCA	DTW
CLE	DEN	1213	2:42	7208		DCA	EMR
CLE	DFW	1021	2:15	7407		DCA	JFK
CLE	DTW	95	0:18	7202	0:24	DCA	LGA
CLE	EMR	404	0:57	7201		DCA	MIA
CLE	JFK	425	1:00	7201		DCA	MSP
CLE	LAX	2053	4:27	7208		DCA	ORD
CLE	LGA	418	0:49	7207		DCA	PHL
CLE	MIA	1080	2:20	7206		DCA	PIT
CLE	MSP	622	1:30	7205		DCA	STL
CLE	MST	921	2:18	7511			
CLE	ORD	316	0:50	7206			
CLE	PHL	363	0:50	7202			
CLE	PIT	105	0:15	7211	0:26		
CLE	SFO	2162	4:45	7211			
CLE	STL	487	1:06	7208			

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TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES DEPARTING DEN				NOMINAL AIRBORNE TIMES DEPARTING DFW			
ROUTE	SEGMENT	DISTANCE ST. MILE	NOMINAL JET TIME	ROUTE	SEGMENT	DISTANCE ST. MILE	NOMINAL JET TIME
DEN	BOS	1766	3:19	DFW	ATL	731	1:27
DEN	CLE	1213	2:15	DFW	PS5	1561	3:05
DEN	DAL	654	1:21	DFW	CLE	1021	2:03
DEN	DFW	645	1:23	DFW	JEN	645	1:31
DEN	JEN	1175	2:05	DFW	DTW	987	1:54
DEN	DTW	1617	2:52	DFW	JFK	142	2:37
DEN	JFK	1638	3:07	DFW	JFK	151	2:36
DEN	LAX	849	1:50	DFW	JFK	114	2:27
DEN	MSP	693	1:21	DFW	JFK	130 ^a	2:41
DEN	MSP	1067	2:15	DFW	ATL	1121	2:11
DEN	MHD	930	1:41	DFW	PS5	952	1:53
DEN	PHL	1570	2:57	DFW	PSY	447	0:51
DEN	PTI	1362	2:41	DFW	PSY	865	2:12
DEN	SEA	1013	2:17	DFW	PSY	1322	2:30
DEN	SFO	856	2:04	DFW	PSY	1057	2:06
DEN	CTI	781	1:54	DFW	PSY	1660	3:47
				DFW	PSY	1465	3:09
				DFW	PSY	550	1:11
				DFW	PSY		7402

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TABLE 1-2 (Continued)

NOMINAL AIRBORNE TIMES DEPARTING DTW				NOMINAL AIRBORNE TIMES DEPARTING EUR			
ROUTE	SEGMENT	ST. MILES	DATE JET TIME	ROUTE	SEGMENT	ST. MILES	DATE JET TIME
DTW	ATL	595	1:19	7202			
DTW	BOS	632	1:17	7201			
DTW	CLE	95	0:23	7209	0:23	7205	
DTW	DAL	962	2:12	7207			
DTW	DCA	405	0:59	7204			
DTW	DEN	1135	2:32	7204			
DTW	DFW	967	1:57	7407			
DTW	EWR	488	1:03	7212			
DTW	JFK	509	1:03	7201			
DTW	LAX	1979	4:09	7208			
DTW	LGA	501	1:04	7210			
DTW	MIA	1146	2:18	7209			
DTW	MSP	528	1:16	7205			
DTW	MSY	926	1:55	7208			
DTW	ORD	235	0:38	7205			
DTW	PHL	454	1:01	7203			
DTW	PIT	211	0:33	7206			
DTW	SFO	2079	4:28	7206			
DTW	STL	440	1:09	7206			

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TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES (LEAVING JFK)				NOMINAL AIRBORNE TIMES (LEAVING LAX)			
ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME
JFK	ATL	760	1:32	7210	LAX	1946	3:37
JFK	BOS	187	0:21	7208	LAX	2611	4:35
JFK	CLE	425	1:07	7205	LAX	2053	3:54
JFK	DAL	1363	2:57	7206	LAX	1246	2:20
JFK	DCA	213	0:40	7203	LAX	849	1:40
JFK	DEN	1638	3:37	7206	LAX	1235	2:23
JFK	DFW	1391	2:58	7407	LAX	1979	3:42
JFK	DTW	509	1:19	7202	LAX	2454	4:10
JFK	EMB	21	0:11	7210	LAX	2475	4:33
JFK	LAX	2475	5:05	7202	LAX	2342	4:18
JFK	MIA	1090	2:14	7209	LAX	1535	3:01
JFK	MSP	1024	2:20	7205	LAX	1670	3:06
JFK	MST	1162	2:29	7208	LAX	1744	3:14
JFK	ORD	740	1:45	7205	LAX	2402	4:27
JFK	PHL	94	0:16	7204	LAX	2136	4:03
JFK	PIT	540	0:42	7203	LAX	2136	4:03
JFK	SEA	2461	5:13	7205	LAX	354	1:58
JFK	SFO	2526	4:49	7206	LAX	338	0:46
JFK	STL	632	2:05	7206	LAX	1592	2:59

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TABLE I-2 (Continued)

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TABLE 1-2 (Continued)

ROUTE	SEGMENT	NOMINAL AIRBORE TIMES DEPARTING MSP			ROUTE	NOMINAL AIRBORE TIMES DEPARTING MSP				
		ST. MILES	NOMINAL JET TIME	DATE YR/MD		ST. MILES	NOMINAL JET TIME	DATE YR/MD		
MSP	ATL	906	1:58	7204	MSP	ATL	425	0:54		
MSP	BOS	1124	2:14	7212	MSP	BOS	1367	2:40		
MSP	CLE	622	1:18	7202	MSP	CLE	921	2:03		
MSP	DAL	853	1:48	7201	MSP	DAL	437	0:56		
MSP	DIA	931	1:52	7211	MSP	DEH	1067	2:22		
MSP	DEN	693	1:32	7211	MSP	DEN	447	1:00		
MSP	DFW	662	1:50	7406	MSP	DTW	926	2:00		
MSP	DIA	528	1:13	7202	MSP	EMB	1167	2:09		
MSP	EMB	1088	2:02	7212	MSP	JFK	1182	2:15		
MSP	JFK	1029	2:02	7201	MSP	LAX	1670	3:31		
MSP	LAX	1535	3:18	7206	MSP	LGA	1183	2:13		
MSP	LGA	1020	2:01	7212	MSP	MIA	675	1:23		
MSP	MIA	1501	3:15	7202	MSP	MIA	837	1:46		
MSP	OMD	334	0:43	7204	1:20	7206	MSP	OMD	1068	2:19
MSP	PHL	981	2:00	7212	MSP	PIT	918	1:50		
MSP	SEA	1399	3:04	7205	MSP	SFO	1911	3:57		
MSP	SEA	1589	3:27	7205	MSP	STL	604	1:21		
MSP	STL	446	1:03	7206	1:51	7304				

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TABLE 1-2 (Continued)

NOMINAL AIRBORNE TIMES DEPARTING ORD				NOMINAL AIRBORNE TIMES DEPARTING PHL			
ROUTE	SEGMENT	ST. MILES	NOMINAL JET TIME	ROUTE	SEGMENT	ST. MILES	NOMINAL JET TIME
ORD	ATL	606	1:07	7209	PHL	ATL	666 1:14
ORD	BOS	867	1:36	7206	PHL	BOS	280 0:36
ORD	CLE	316	0:38	7203	PHL	CLE	363 0:57
ORD	DAL	799	1:35	7204	PHL	DAL	1295 2:46
ORD	DCA	612	1:13	7202	PHL	DCA	120 0:25
ORD	DEN	900	1:57	7206	PHL	DEN	1570 3:33
ORD	DFW	802	1:38	7411	PHL	DFW	1302 2:43
ORD	DTW	235	0:31	7201	PHL	DTW	454 1:10
ORD	EMR	719	1:24	7211	PHL	EMR	81 0:18
ORD	JFK	740	1:27	7202	PHL	JFK	93 0:21
ORD	LAX	1744	3:35	7212	PHL	LAX	2402 5:06
ORD	LGA	733	1:26	7212	PHL	LGA	95 0:25
ORD	MIA	1198	2:23	7203	PHL	MIA	1014 2:05
ORD	MSP	334	0:51	7208	PHL	MSP	980 2:18
ORD	MSY	837	1:47	7235	PHL	MSY	1088 2:25
ORD	PHL	678	1:21	7201	PHL	ORD	678 1:36
ORD	PIT	412	0:54	7202	PHL	PIT	268 0:43
ORD	SEA	1720	3:43	7208	PHL	SFO	2521 5:31
ORD	SFO	1946	3:53	7208	PHL	STL	814 1:55
ORD	STL	238	0:38	7205			7207
ORD							7212

TABLE I-2 (Continued)

ROUTE	SEGMENT	NOMINAL AIRBORNE TIMES DEPARTING PIT			ROUTE	NOMINAL AIRBORNE TIMES DEPARTING SEA			DATE YR/MO
		ST. MILES	NOMINAL JET TIME	DATE YR/MO		NOMINAL PROP TIME	ST. MILES	NOMINAL PROP TIME	
PIT	ATL	526	1:09	7207					
PIT	BOS	496	1:09	7201	1:51	7307	SEA	2496	4:57
PIT	CLE	105	0:15	7212	0:32	7204	SEA	1669	3:16
PIT	DAL	1061	2:09	7201			SEA	1019	2:02
PIT	DCA	205	0:33	7202			SEA	1660	3:18
PIT	DEN	1302	2:54	7308			SEA	2421	4:31
PIT	DFW	1067	2:18	7408			SEA	954	1:54
PIT	DTW	201	0:35	7206			SEA	1399	2:42
PIT	EMR	319	0:50	7201	1:17	7209	SEA	1720	3:14
PIT	JFK	340	0:46	7204	1:24	7305	SFO	678	1:23
PIT	LAX	2136	4:36	7207			SEA	1709	3:11
PIT	LGA	335	0:46	7211	1:09	7211			
PIT	MIA	1013	2:00	7212					
PIT	MSY	918	1:59	7202					
PIT	ORD	412	1:04	7208	1:43	7209			
PIT	PHL	268	0:33	7210	1:00	7211			
PIT	SFO	2254	4:53	7205					
PIT	STL	553	1:22	7206	1:59	7303			

TABLE I-2 (Continued)

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TABLE I.3
NOMINAL DEPARTURE AND ARRIVAL GROUND TIME*

ARRIVAL	DEPARTURE
ATL	8
BOS	9
CLE	7
DIA	9
DEV	5
DFW	6
DTW	8
FNL	9
JFK	15
LAX	9
LGA	8
MIA	7
MSP	5
MSY	4
ORD	9
PHL	7
PIT	2
SFA	6
SFO	8
STL	5
	2

ALL TIMES ARE IN MINUTES

*Ground times (taxi times, including holding, to and from the ramp)

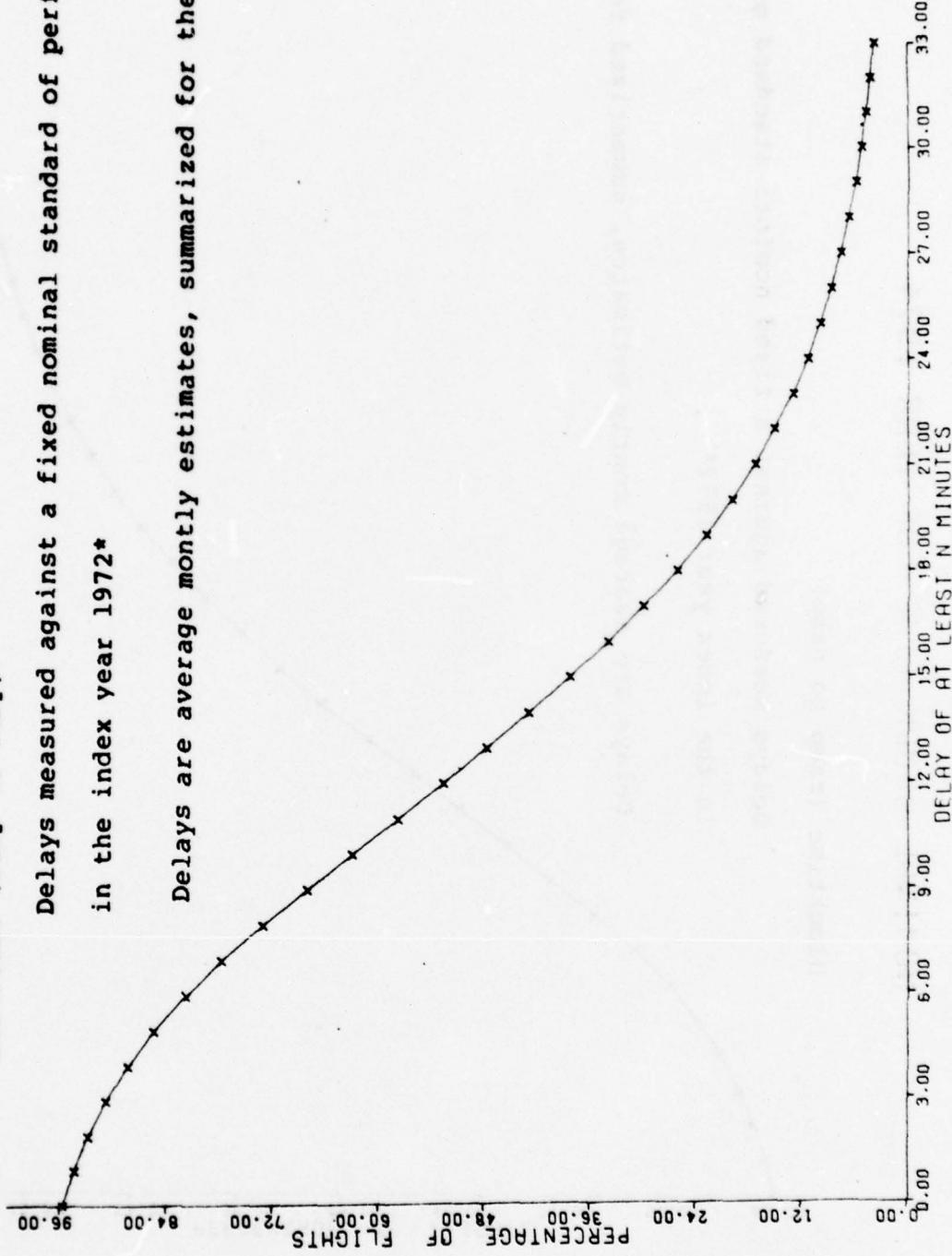
FIGURE 1.3

NOMINAL BLOCK TIME FOR YEAR 1973

Blocktime (ramp to ramp)

Delays measured against a fixed nominal standard of performance
in the index year 1972*

Delays are average monthly estimates, summarized for the year.



-21-

*see attached Tables I-2 and I-3.

(reference FAA-EM-77-12; p. 3)

FIGURE 1.4

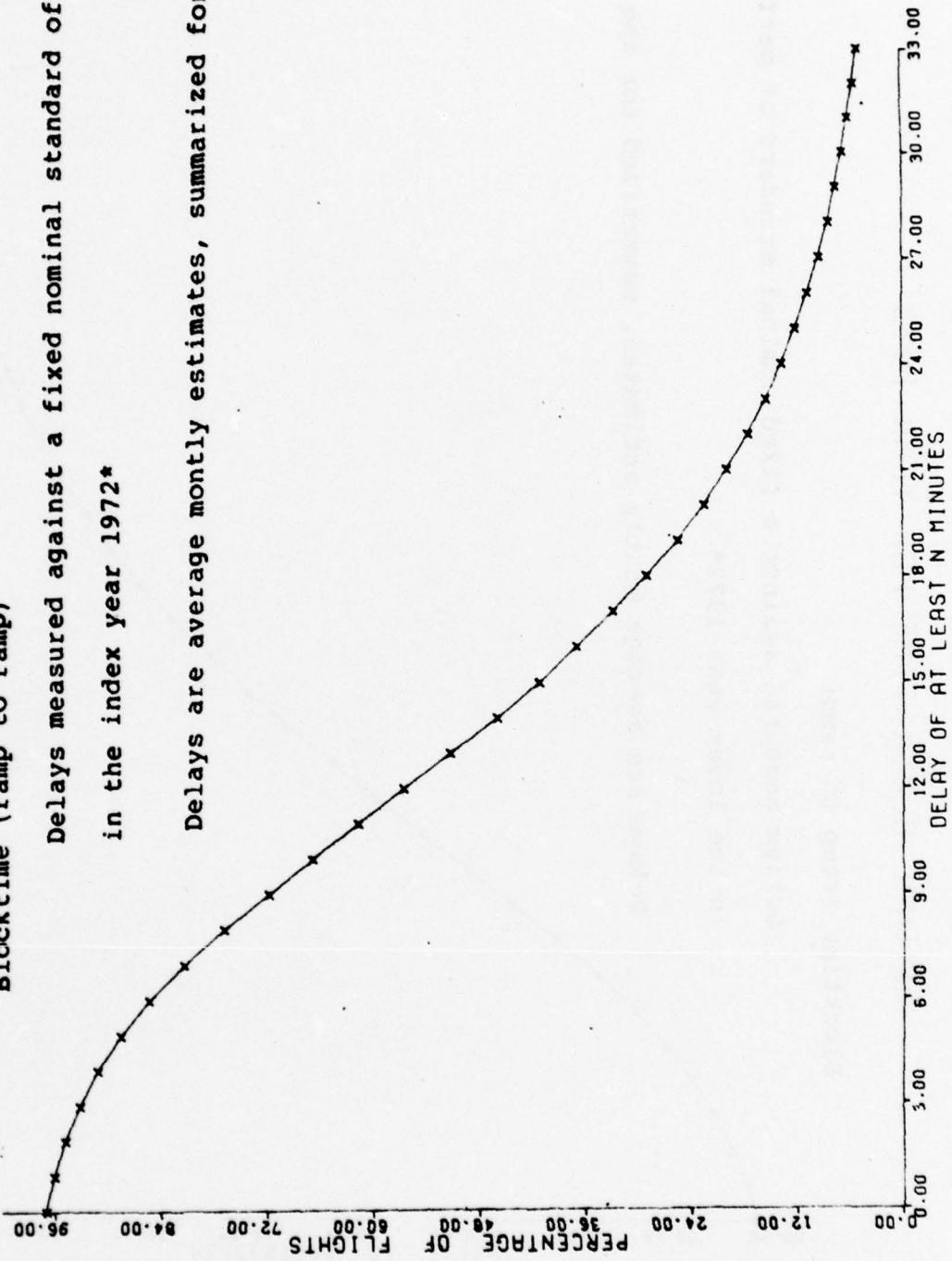
NOMINAL BLOCK TIME FOR YEAR 1974

Blocktime (ramp to ramp)

Delays measured against a fixed nominal standard of performance
in the index year 1972*

Delays are average monthly estimates, summarized for the year.

-22-



*see attached Tables I-2 and I-3.

(reference FAA-EM-77-12; p. 3)

FIGURE 1.5

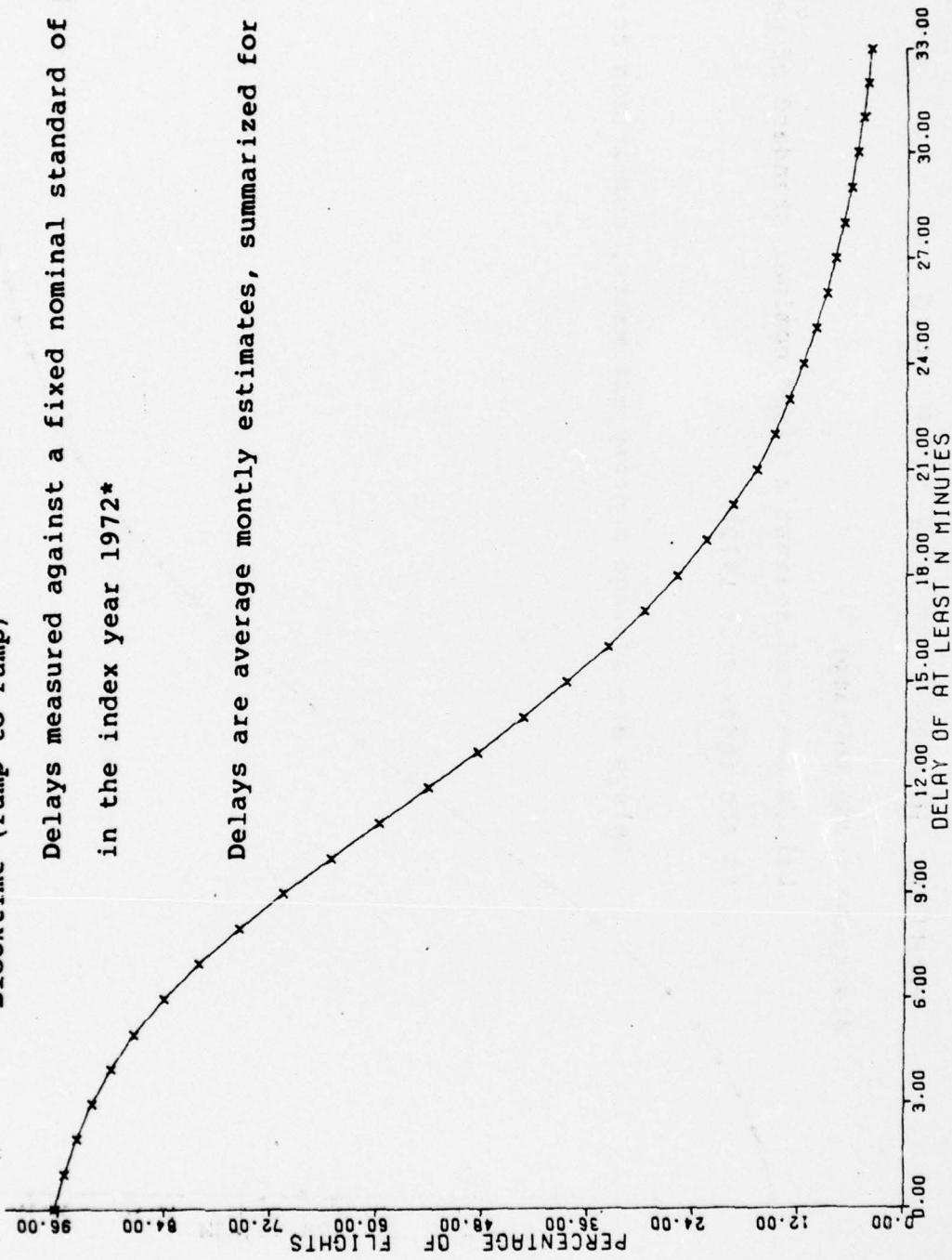
NOMINAL BLOCK TIME FOR YEAR 1975

Blocktime (ramp to ramp)

Delays measured against a fixed nominal standard of performance
in the index year 1972*

Delays are average monthly estimates, summarized for the year.

-23-



*see attached Tables I-2 and I-3.
(reference FAA-EM-77-12; p.3)

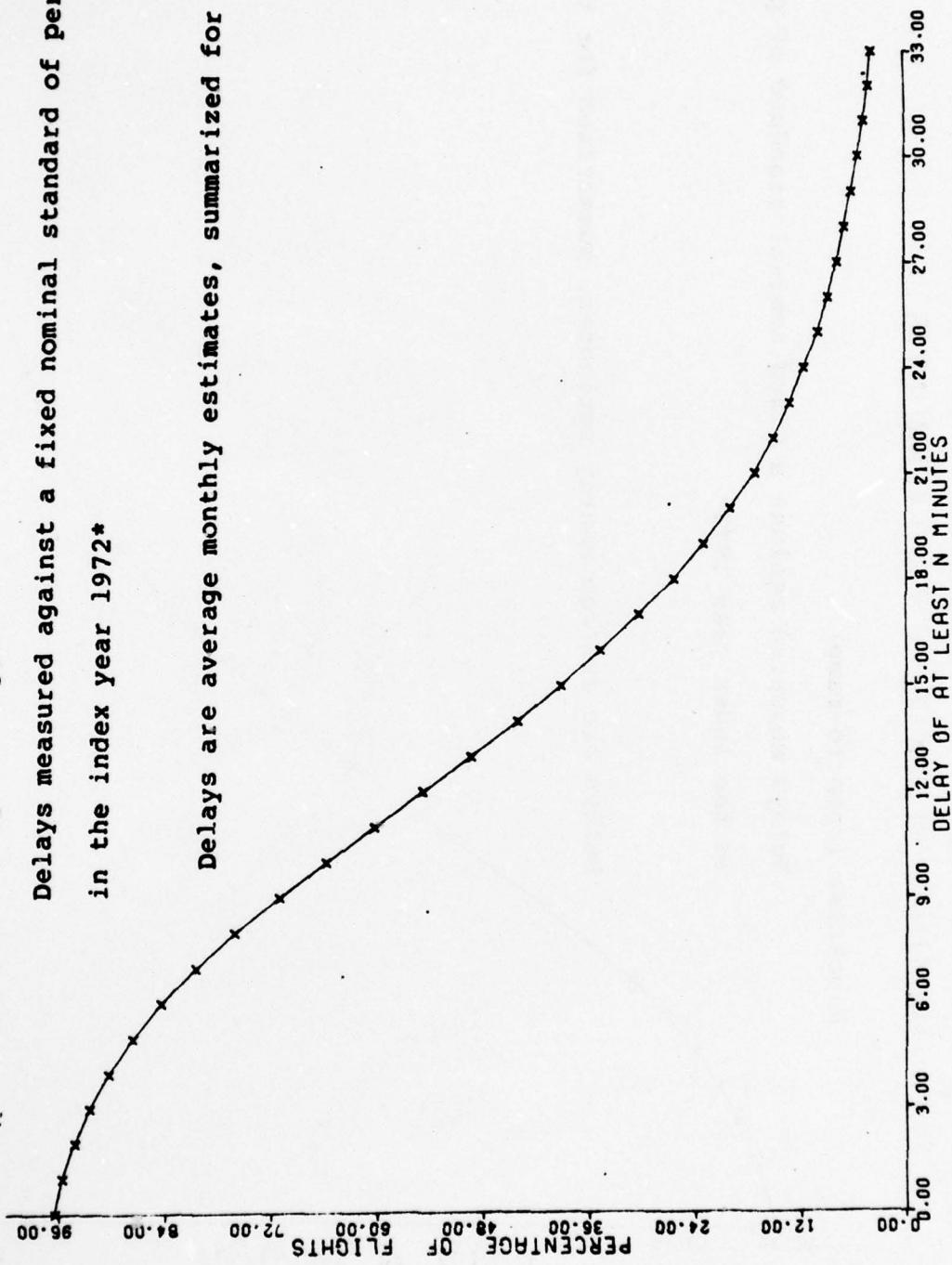
FIGURE 1.6

NOMINAL BLOCK TIME FOR YEAR 1976

Blocktime (ramp to ramp)

Delays measured against a fixed nominal standard of performance
in the index year 1972*

Delays are average monthly estimates, summarized for the year.



-24-

*see attached Tables I-2 and I-3.
(reference FAA-EM-77-12; p.3)

FIGURE 1.7

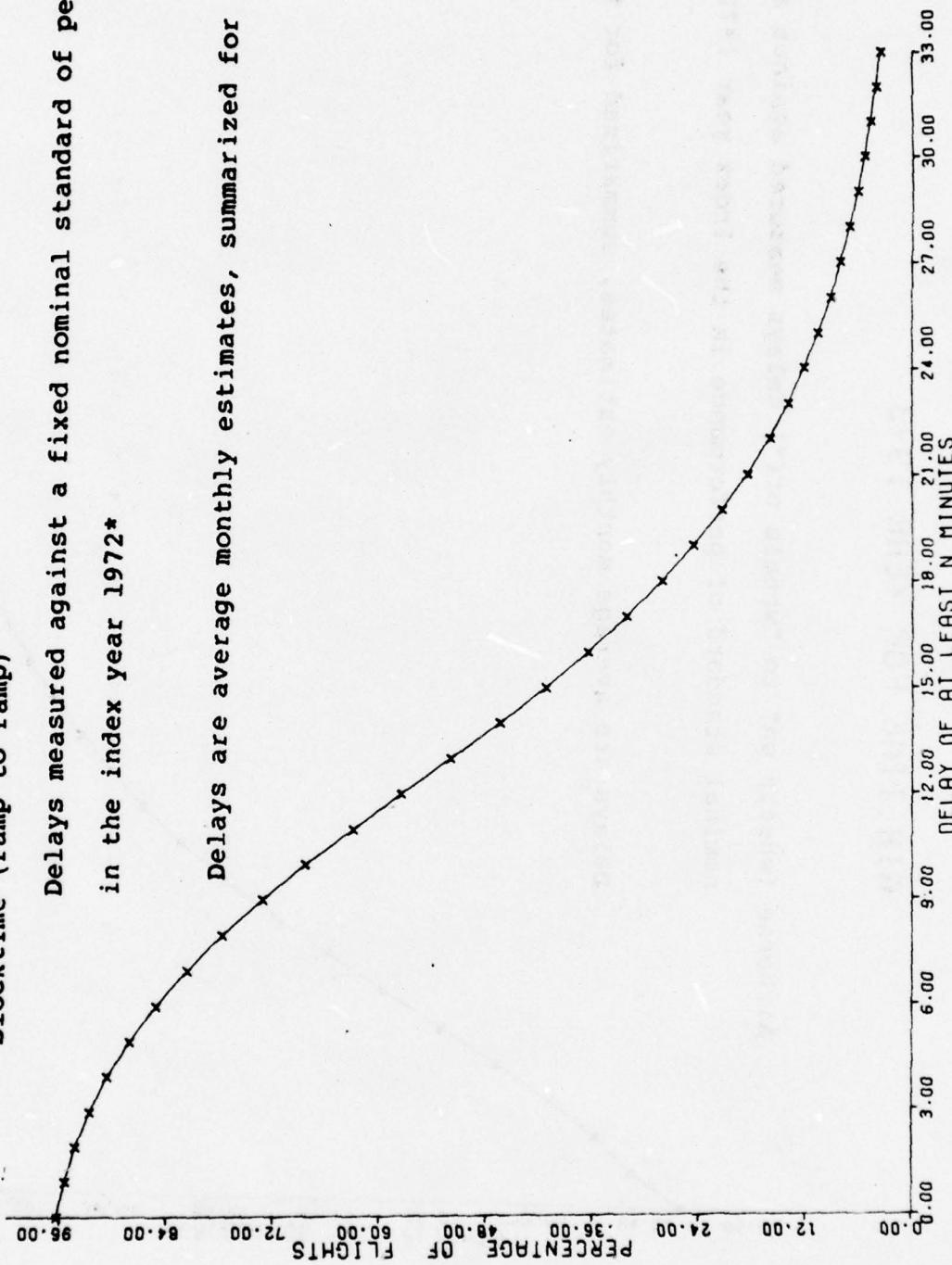
NOMINAL BLOCK TIME FOR YEAR 1977

Blocktime (ramp to ramp)

Delays measured against a fixed nominal standard of performance
in the index year 1972*

Delays are average monthly estimates, summarized for the year.

-25-



*see attached Tables I-2 and I-3.

(reference FAA-EM-77-12; p.3)

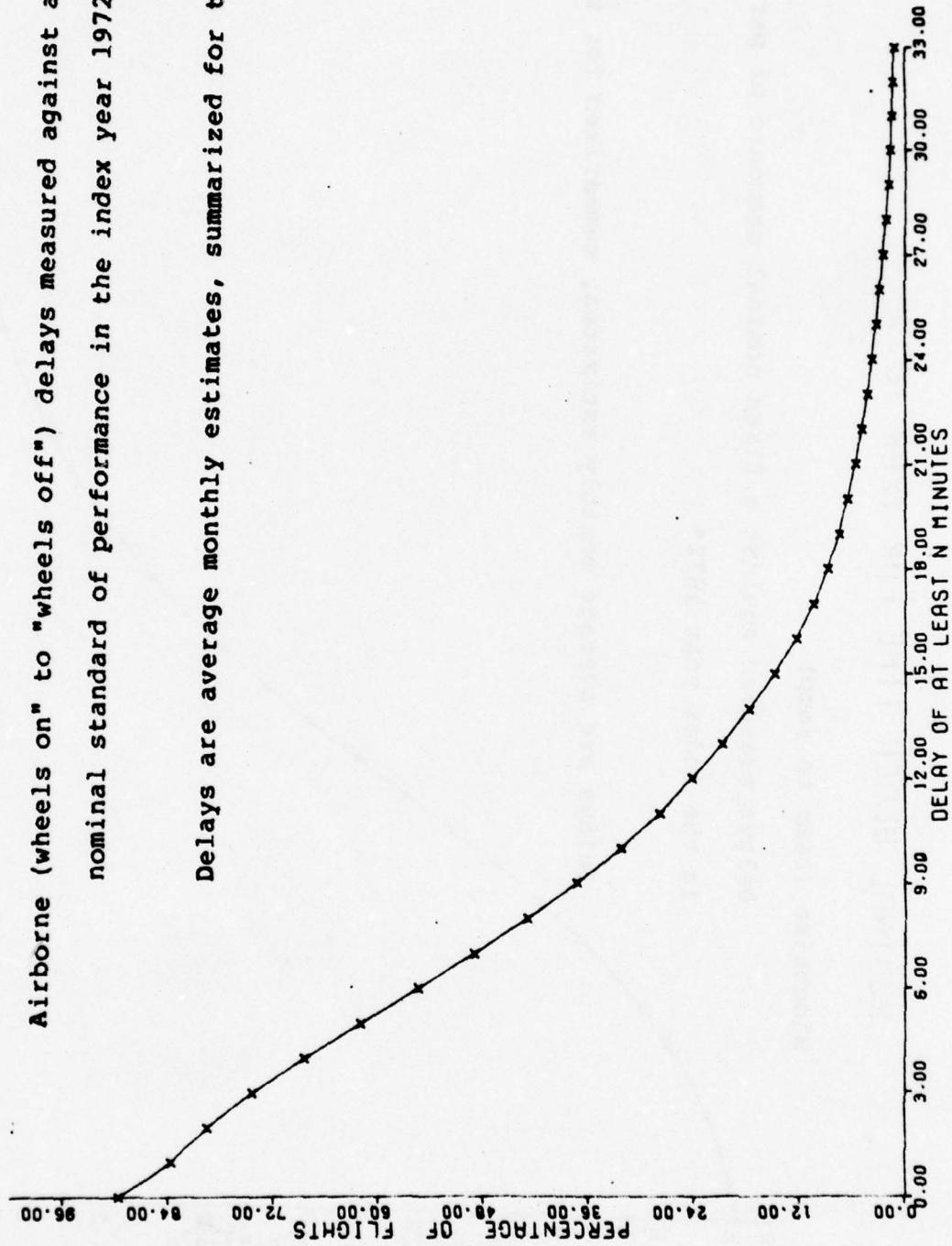
FIGURE 2.3

AIR TIME FOR YEAR 1973

Airborne ("wheels on" to "wheels off") delays measured against a fixed nominal standard of performance in the index year 1972*

Delays are average monthly estimates, summarized for the year.

-26-



*see attached Table I-2.

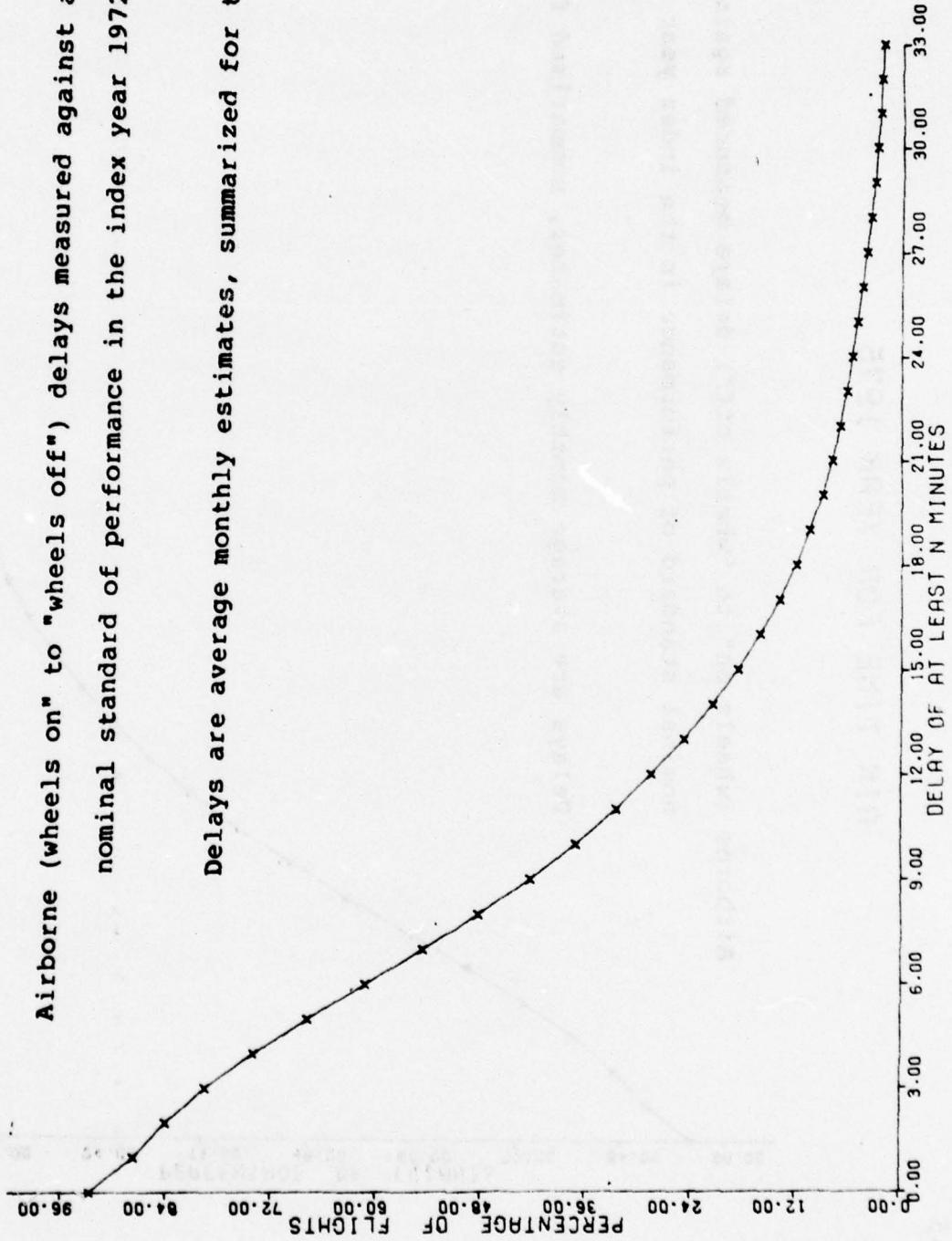
FIGURE 2-4

AIR TIME FOR YEAR 1974

Airborne (wheels on" to "wheels off") delays measured against a fixed nominal standard of performance in the index year 1972*

Delays are average monthly estimates, summarized for the year.

-27-



*see attached Table I-2.

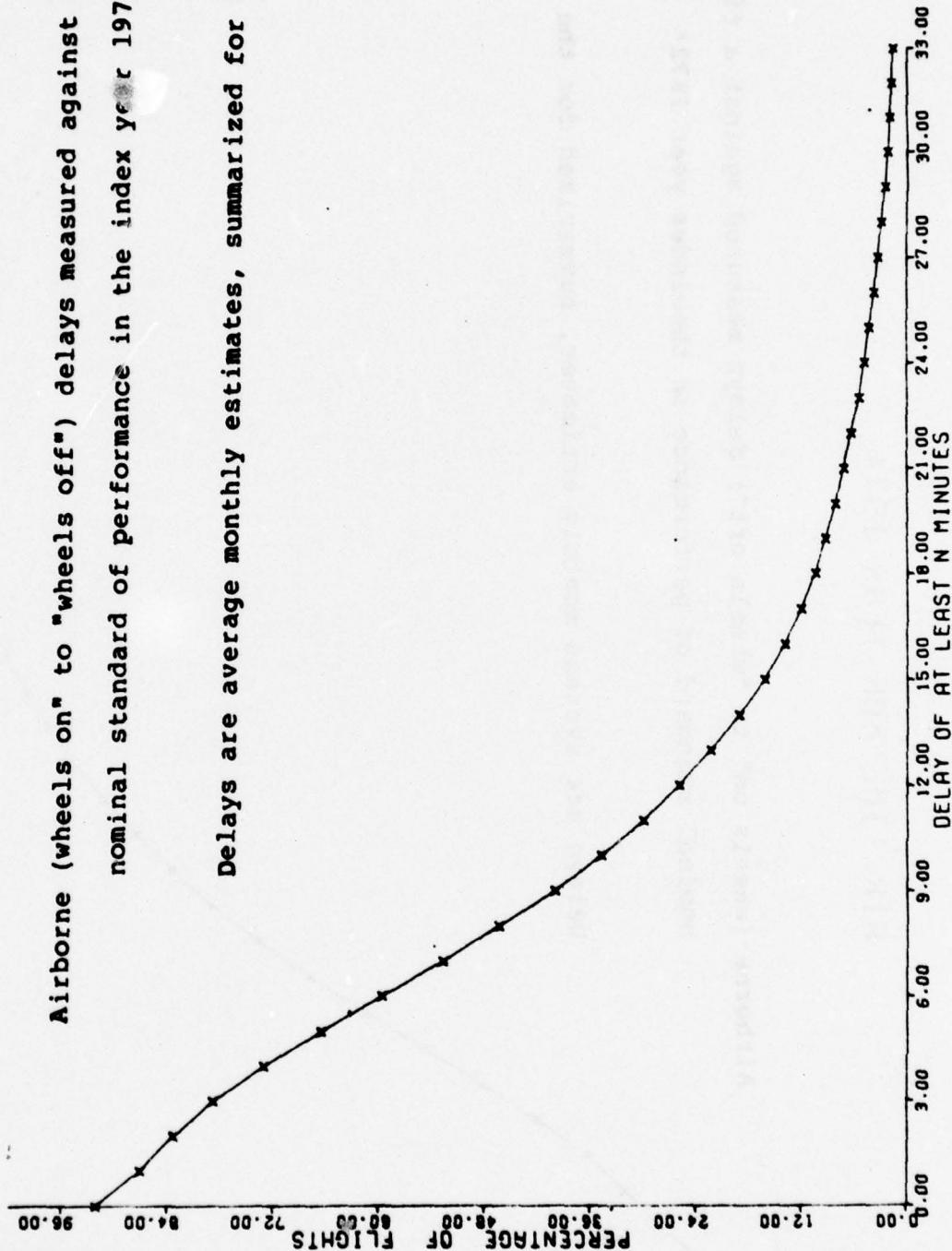
FIGURE 2.5

AIR TIME FOR YEAR 1975

Airborne ("wheels on" to "wheels off") delays measured against a fixed nominal standard of performance in the index year 1972*

Delays are average monthly estimates, summarized for the year.

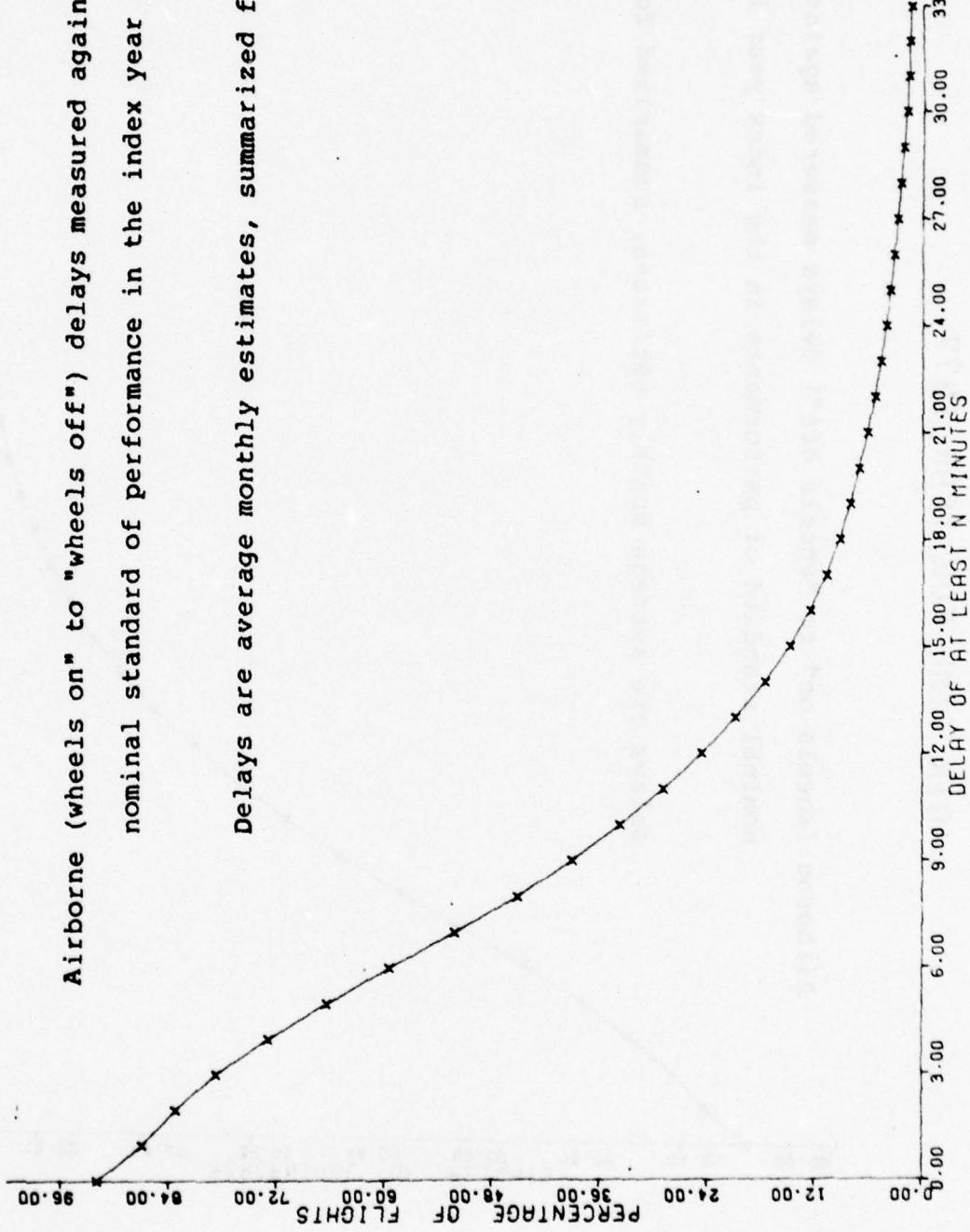
-28-



*see attached Table I-2.

FIGURE 2.6

AIR TIME FOR YEAR 1976



*see attached Table I-2.

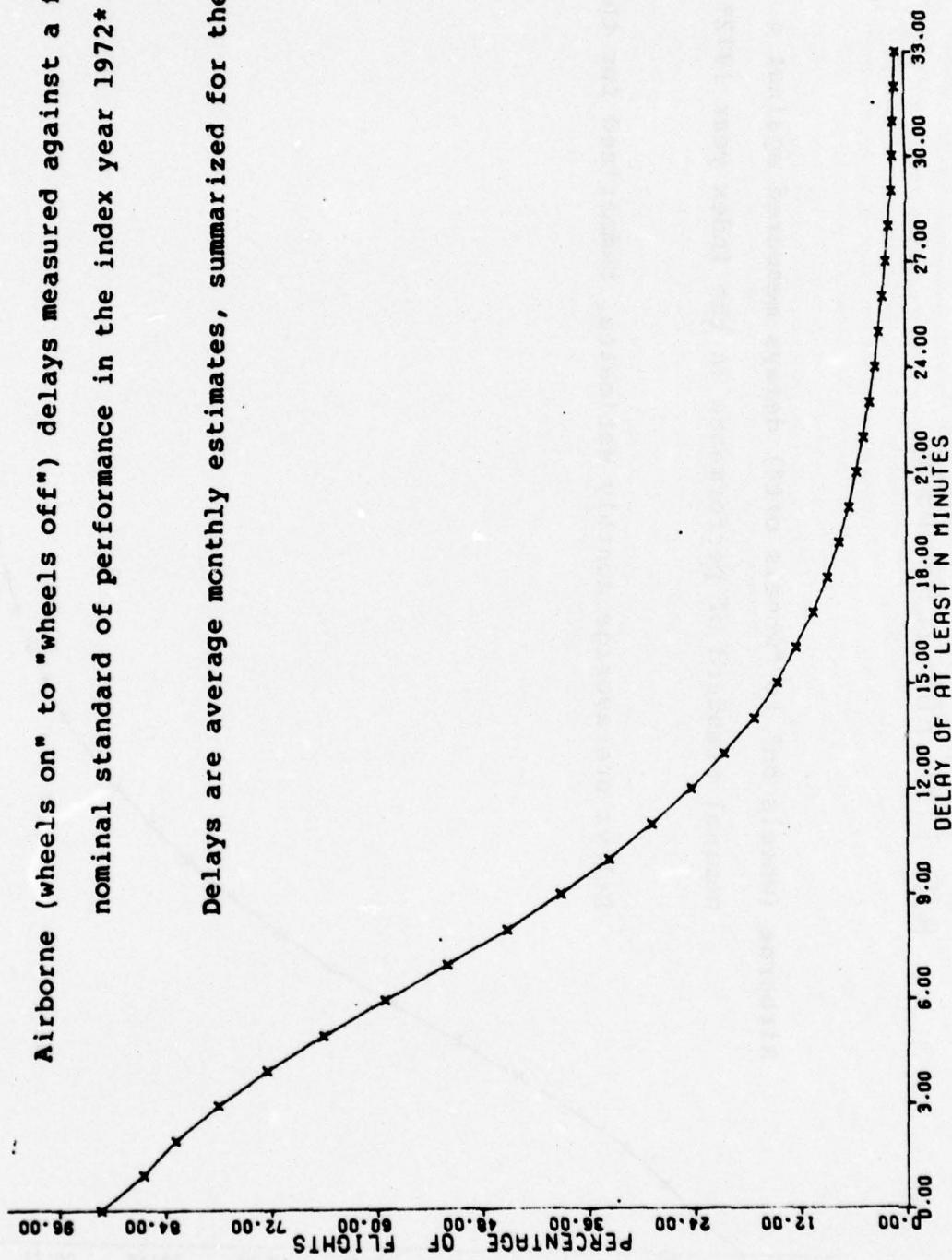
FIGURE 2-7

AIR TIME FOR YEAR 1977

Airborne ("wheels on" to "wheels off") delays measured against a fixed nominal standard of performance in the index year 1972*

Delays are average monthly estimates, summarized for the year.

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*see attached Table I-2.

TABLE 2

COMPARISON 50th PERCENTILE RANKING OF DELAYS

- A. Delays measured against nominal block time standard
- B. Delays measured against nominal airborne time standard
- C. Delays measured against OAG trip time standard

	<u>A. x Nominal Block</u> (minutes)	<u>B. x Nominal Airborne</u> (minutes)	<u>C. x OAG Std.</u> (minutes)
	N. A.	N. A.	N. A.
1972			
1973	12.53	6.85	3.40
1974	13.23	7.75	3.55
1975	12.75	7.41	2.26
1976	12.85	7.33	2.21
1977	13.36	7.32	2.36

REF: FIGS. 1 THRU 3

FIGURE 3.3

OAG FOR YEAR 1973

Blocktime (ramp to ramp) delays measured against the standard published in the Official Airline Guide. Delays are averaged monthly estimates, summarized for the year.

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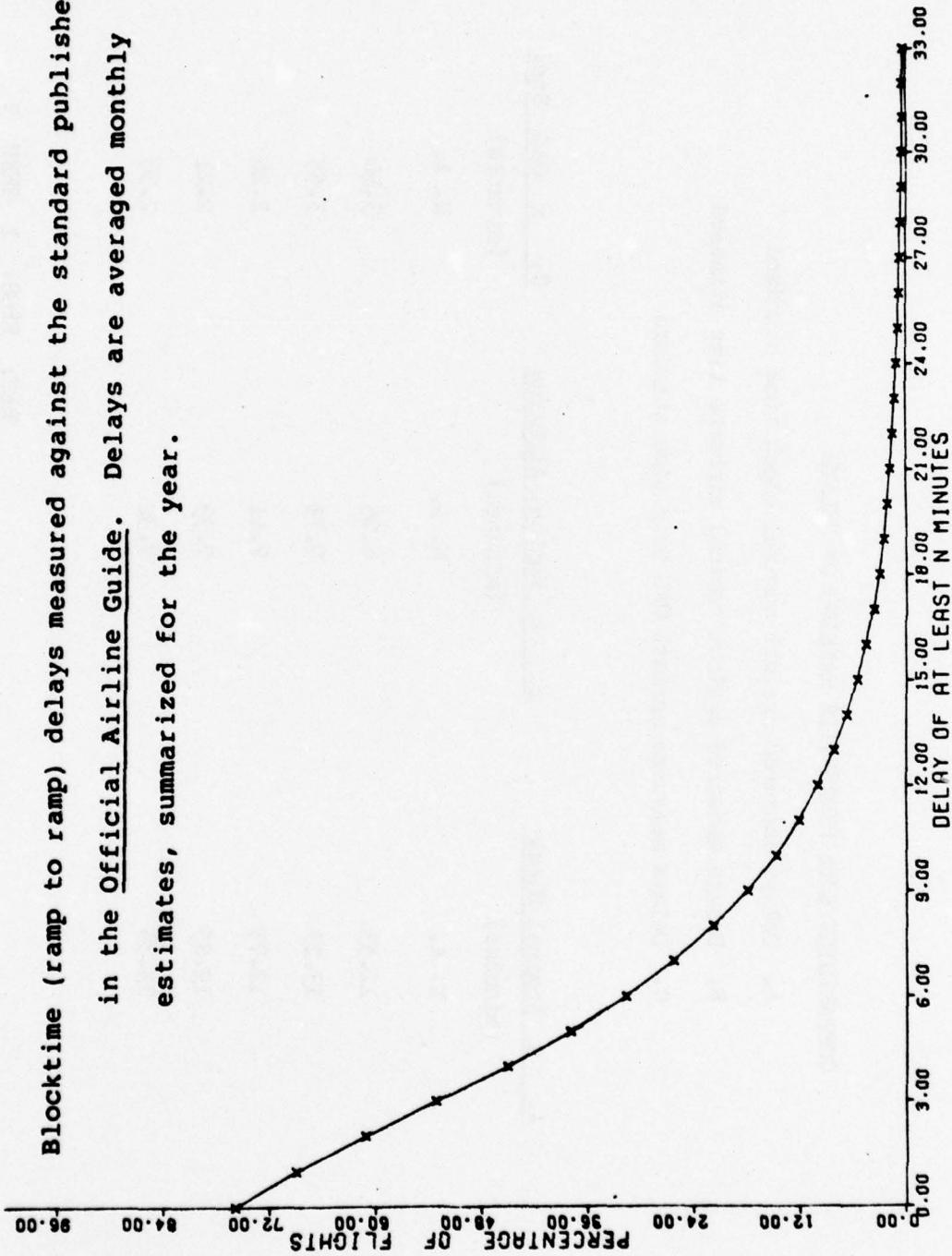


FIGURE 3.4

OAG FOR YEAR 1974

Blocktime (ramp to ramp) delays measured against the standard published in the Official Airline Guide. Delays are averaged monthly estimates, summarized for the year.

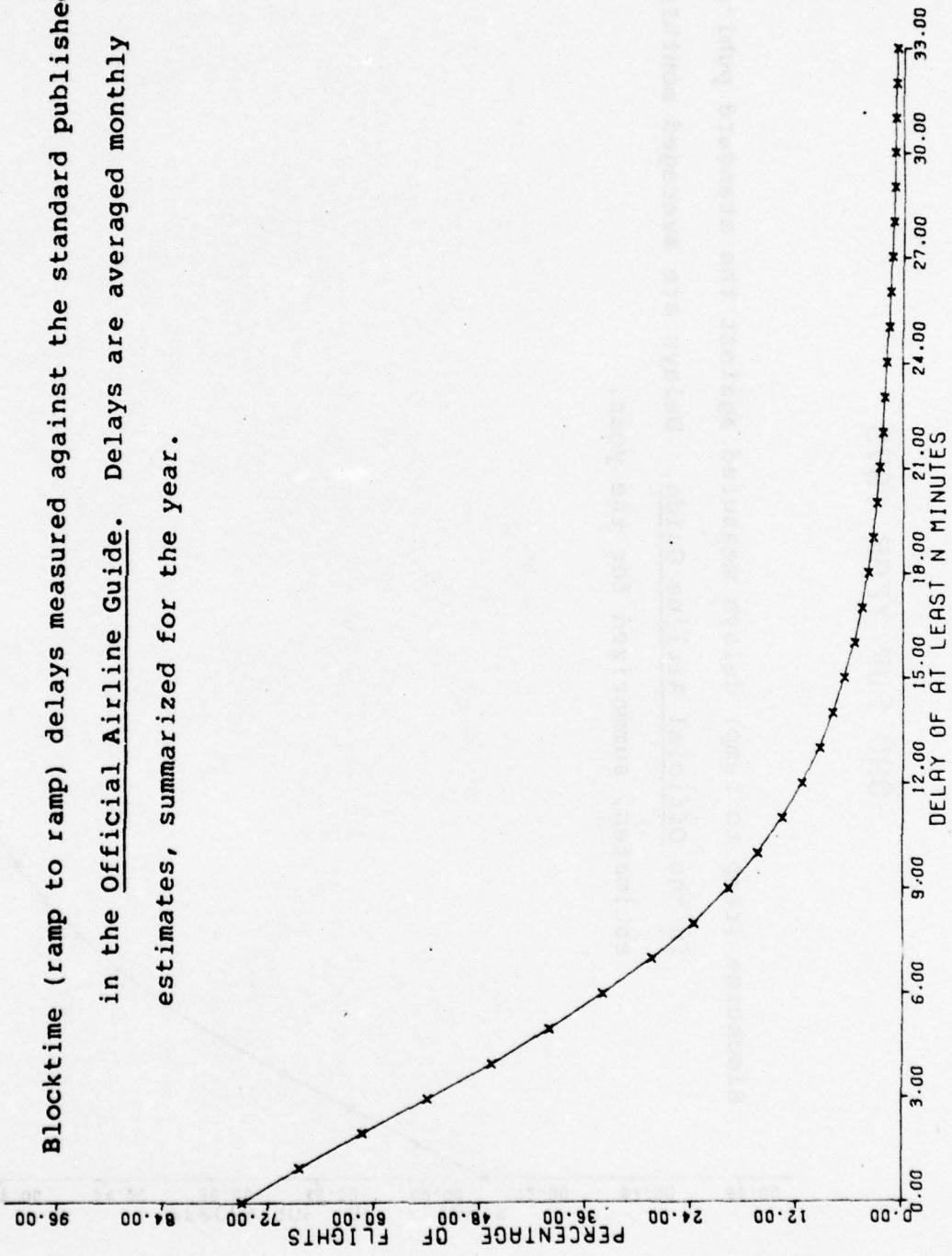


FIGURE 3.5

OAG FOR YEAR 1975

Blocktime (ramp to ramp) delays measured against the standard published in the Official Airline Guide. Delays are averaged monthly estimates, summarized for the year.

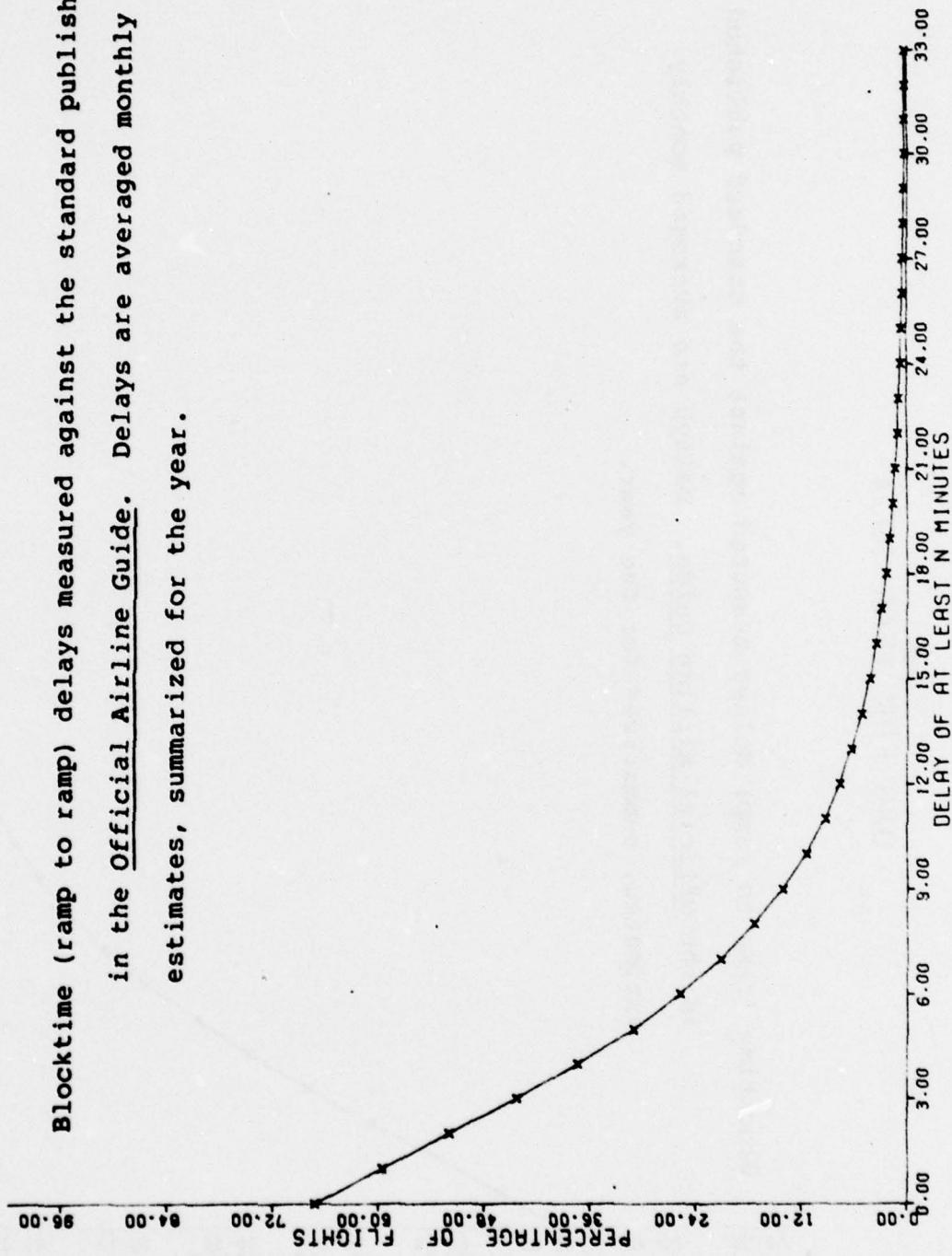


FIGURE 3.6

OAG FOR YEAR 1976

Blocktime (ramp to ramp) delays measured against the standard published in the Official Airline Guide. Delays are averaged monthly estimates, summarized for the year.

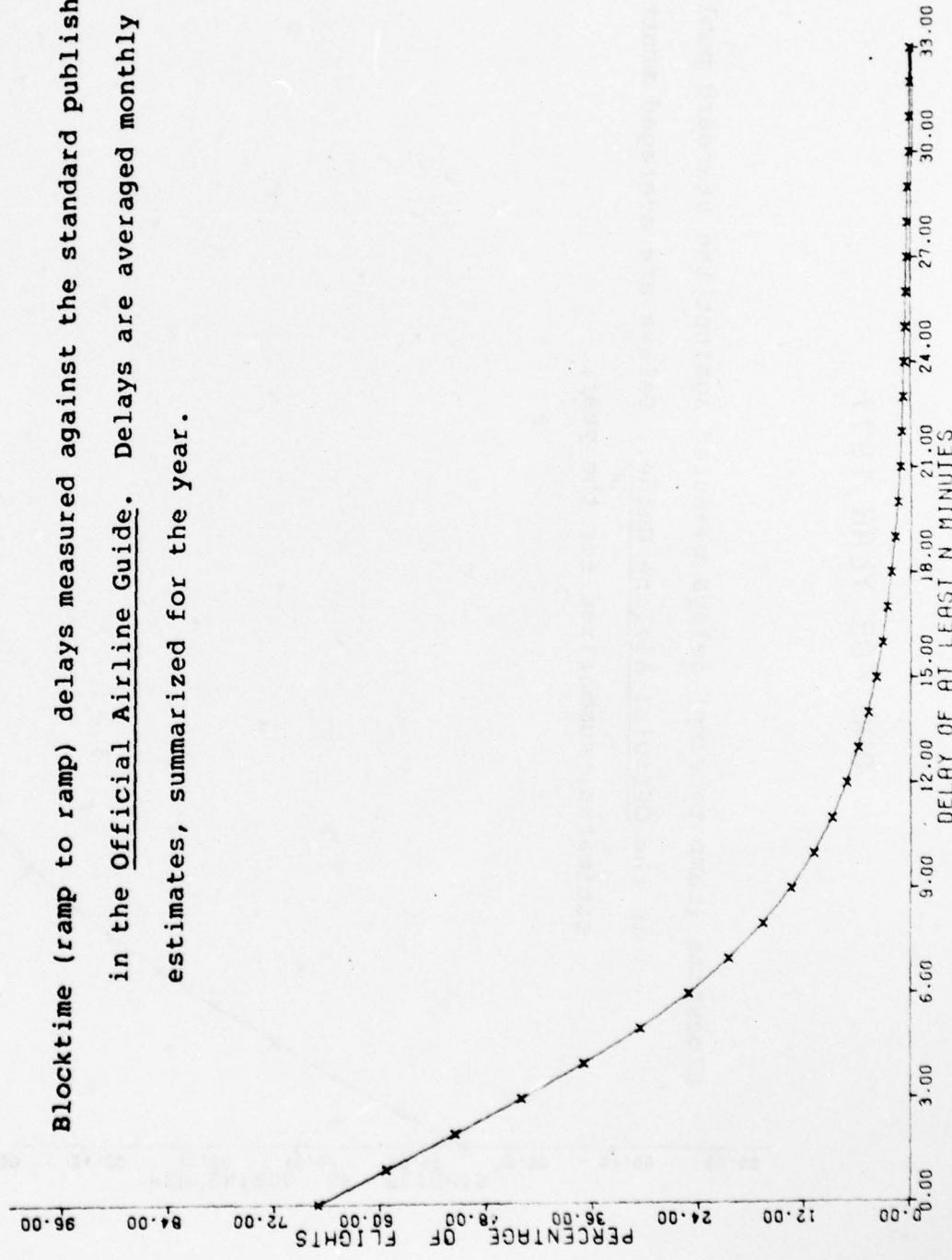


FIGURE 3.7

OAG FOR YEAR 1977

Blocktime (ramp to ramp) delays measured against the standard published in the Official Airline Guide. Delays are averaged monthly estimates, summarized for the year.

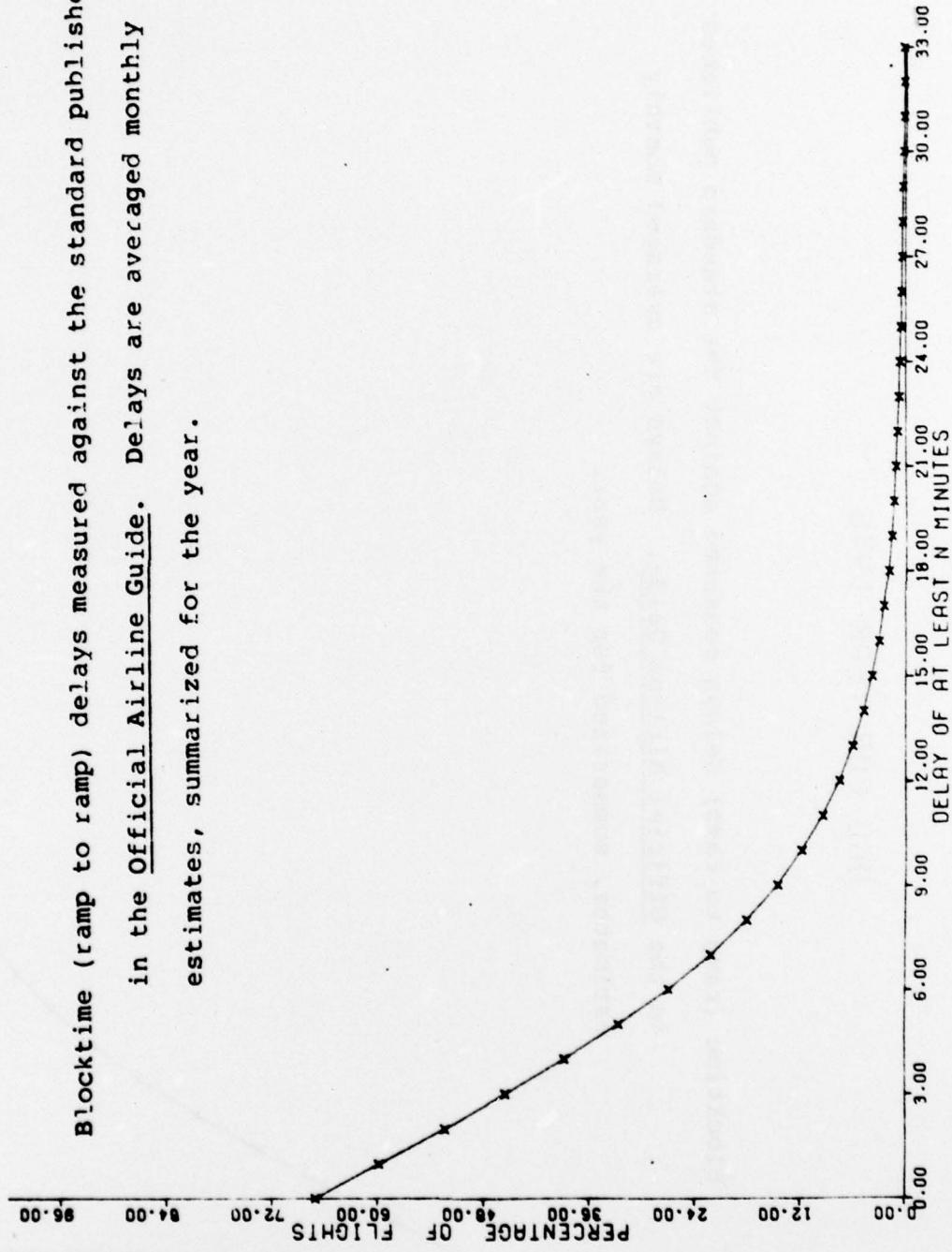


FIGURE 4.1

AVERAGE MONTHLY AIRBORNE AND GROUND DELAYS
COMPOSITE FOR TOP 50 ROUTE SEGMENTS

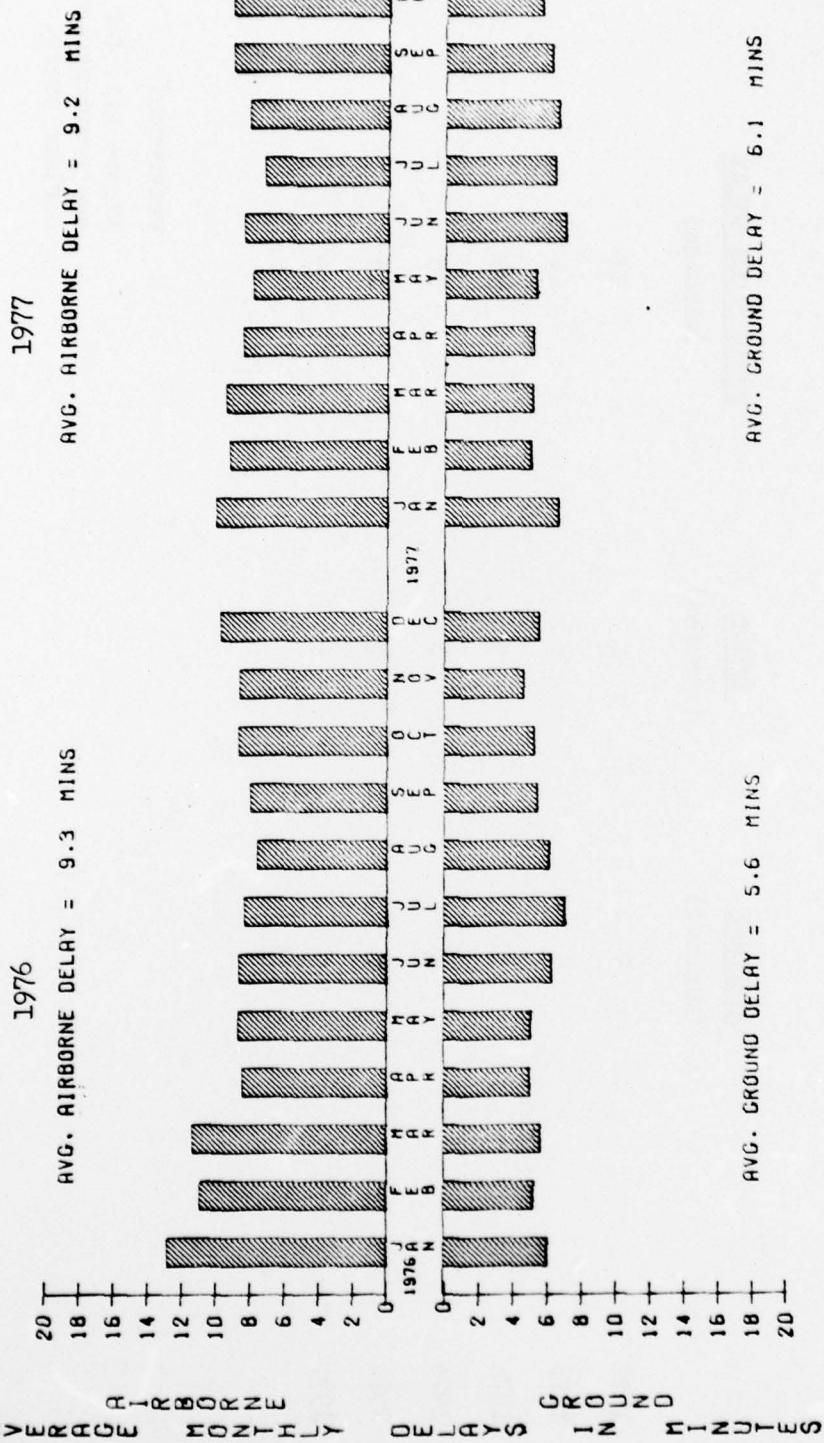


TABLE 3

ANNUAL TREND IN AVERAGE MONTHLY DELAYS
COMPOSITE OF TOP 50 ROUTE SEGMENTS

	<u>AIRBORNE</u> (minutes)	<u>GROUND</u> (minutes)	<u>TOTAL BLOCK DELAY</u> (minutes)
1972	9	4	13
1973	9	6	15
1974	11	5	16
1975	10	5	15
1976	9	6	15
1977	9	6	15

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reference:

Figure 4.1, for years 1976-1977
see previous annual reports for
earlier years.

FIGURE 4.2 AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT ATL TO DFW

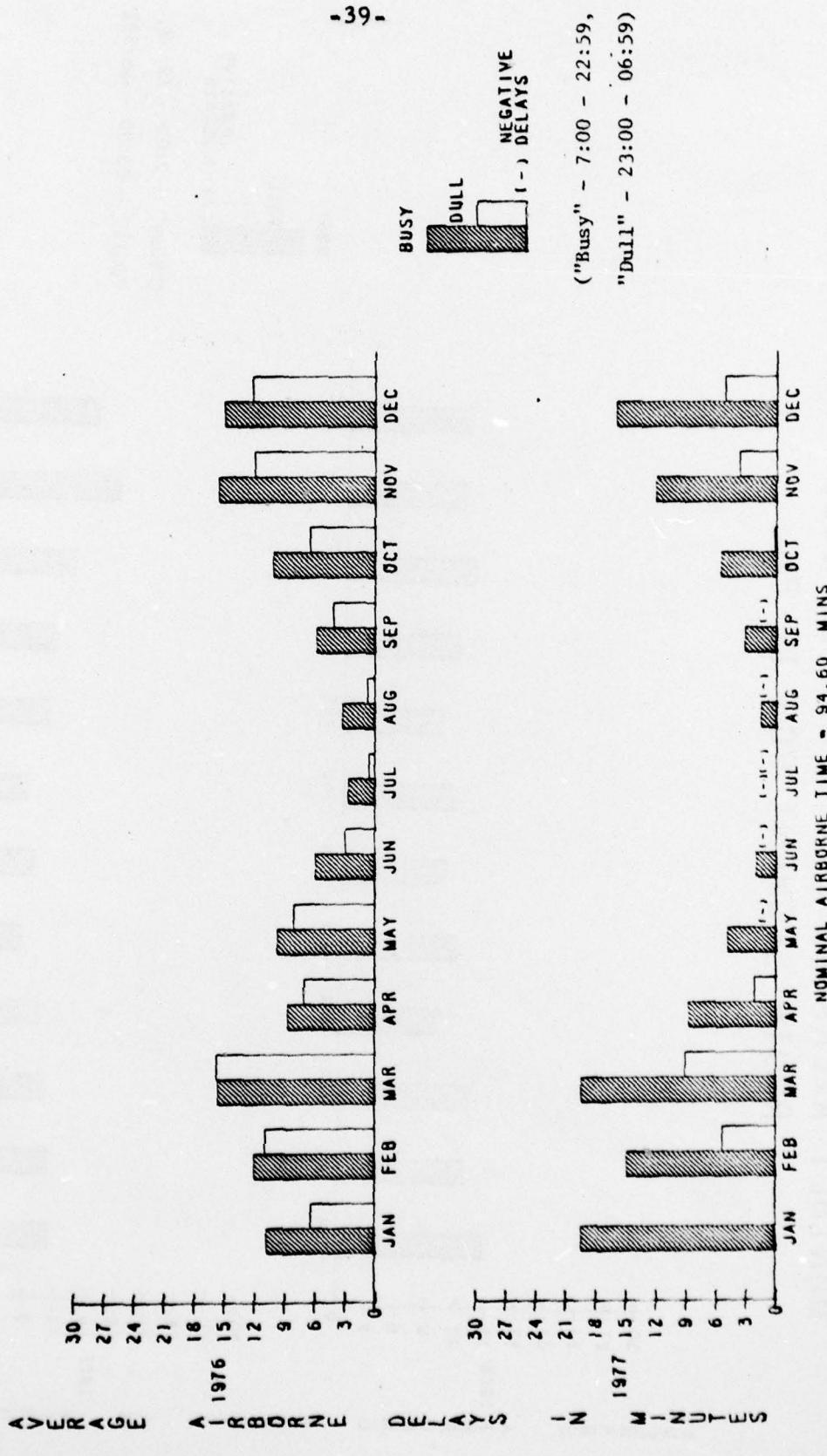
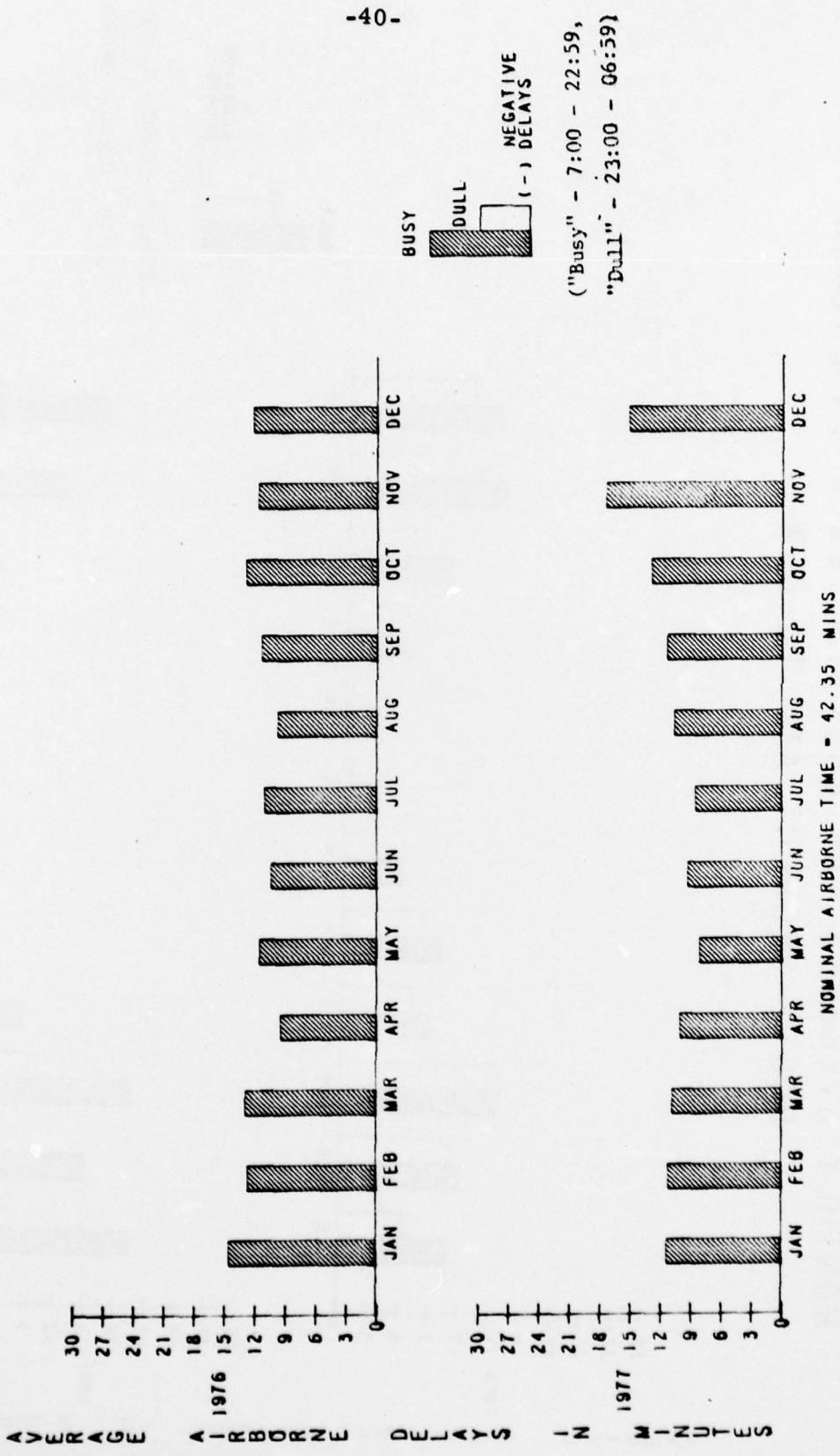


FIGURE 4,3

AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT BOS TO PHL



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FIGURE 4-4 AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
 MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
 ROUTE SEGMENT CLE TO DTW

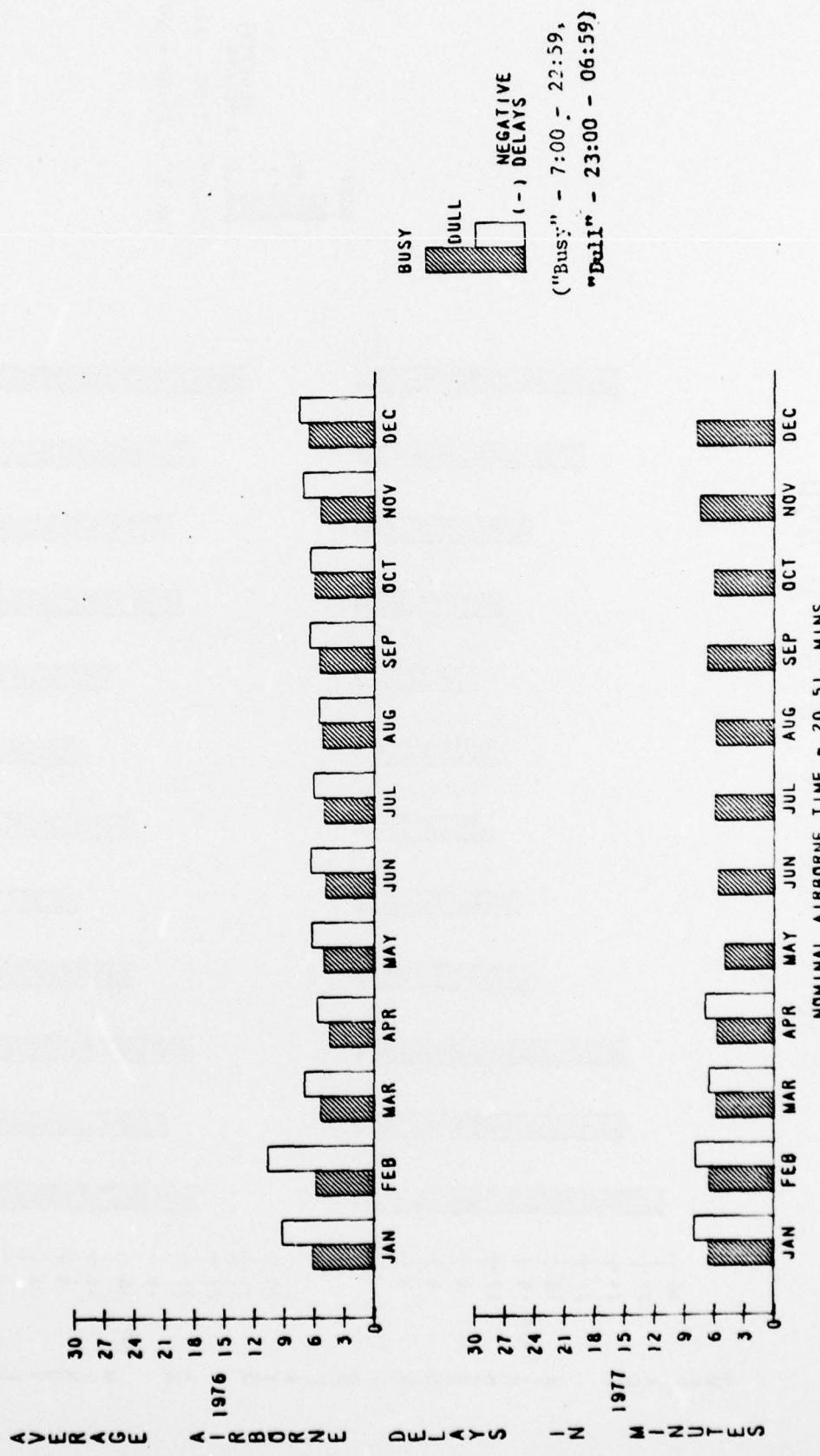


FIGURE 4.5

AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT DCA TO ORD

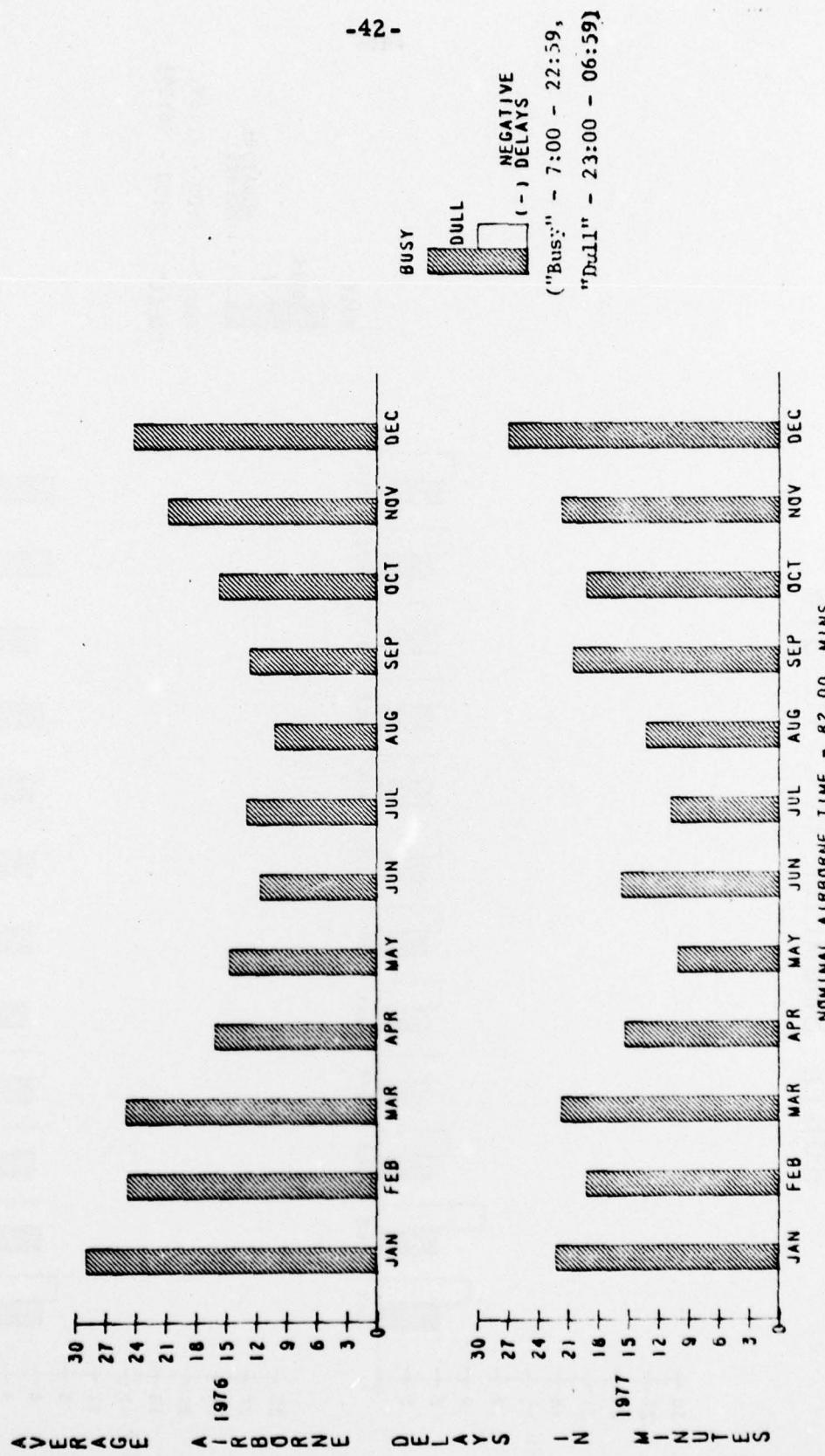


FIGURE 4-6

AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT DEN TO ORD

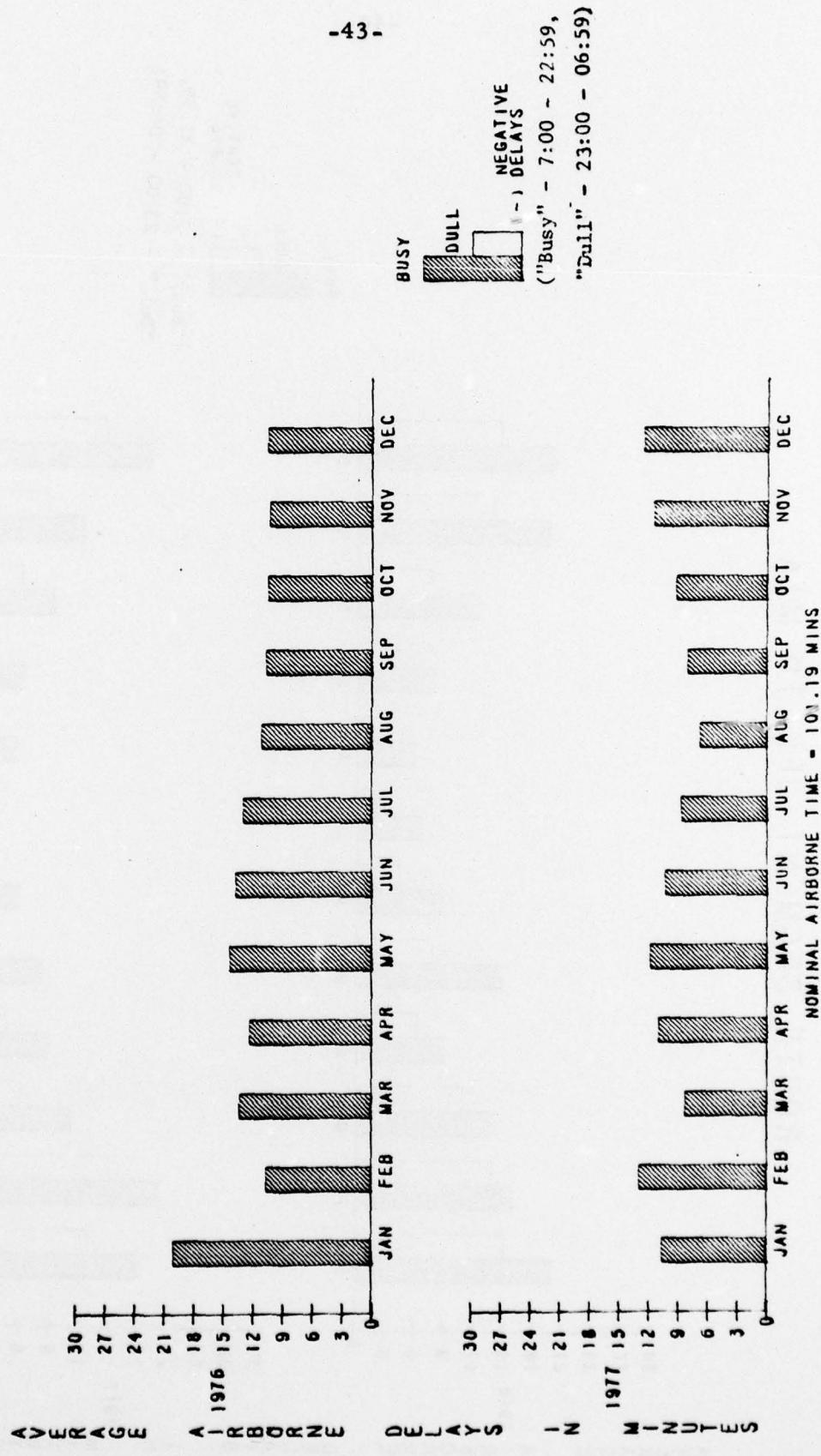


FIGURE 4.7 AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT JFK TO MIA

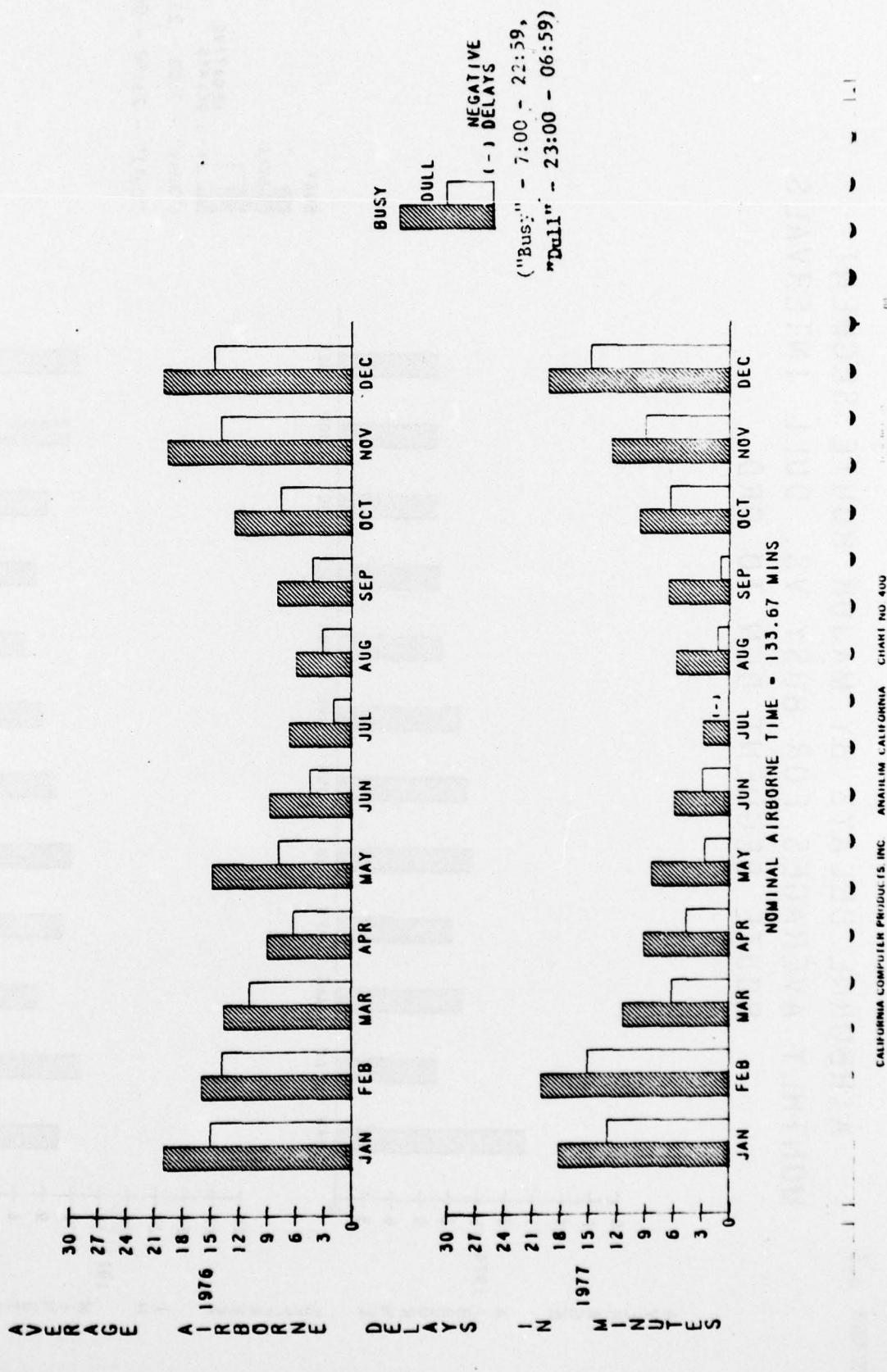


FIGURE 4.8 AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT LAX TO SFO

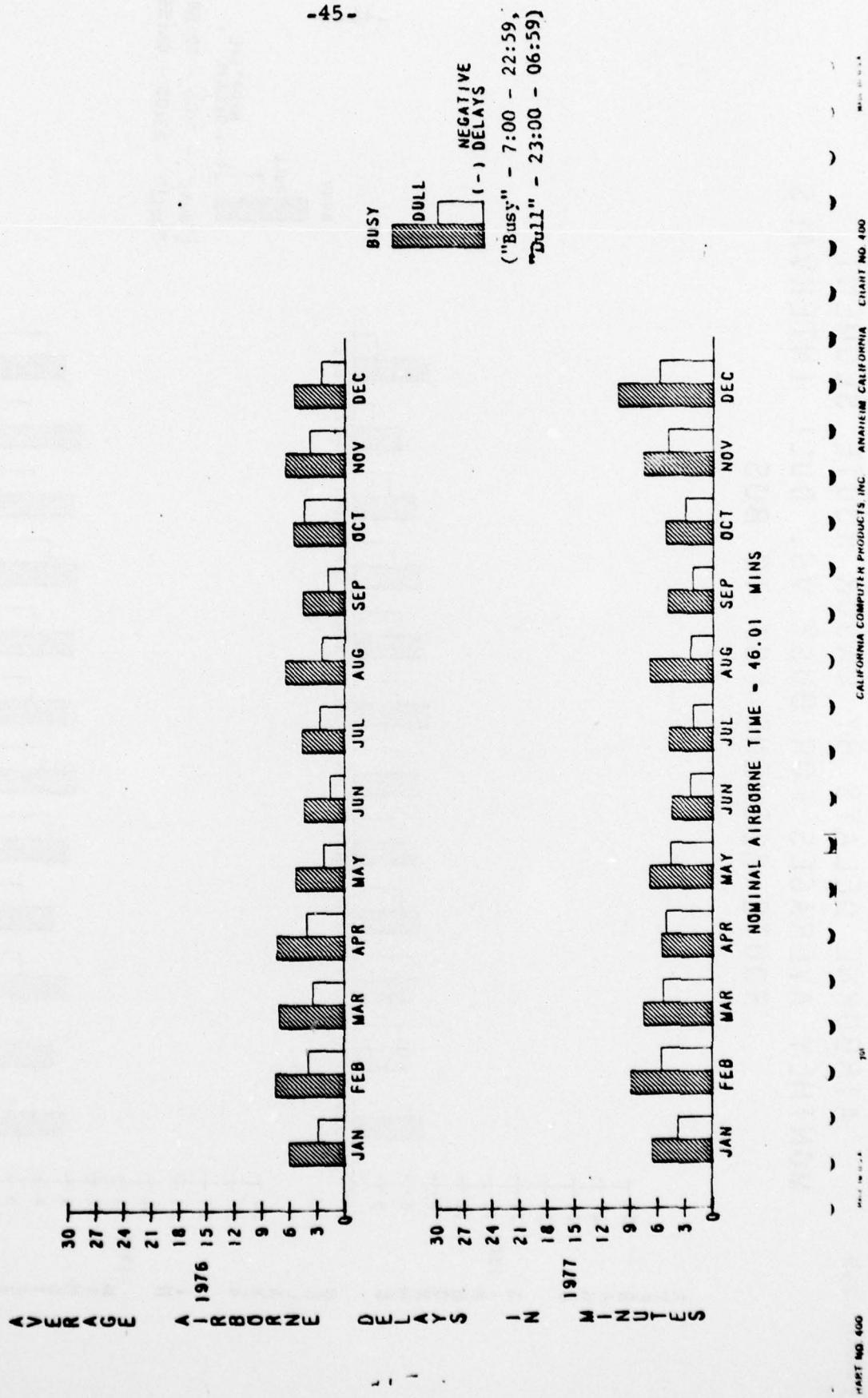


FIGURE 2.9

AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT LGA TO BOS

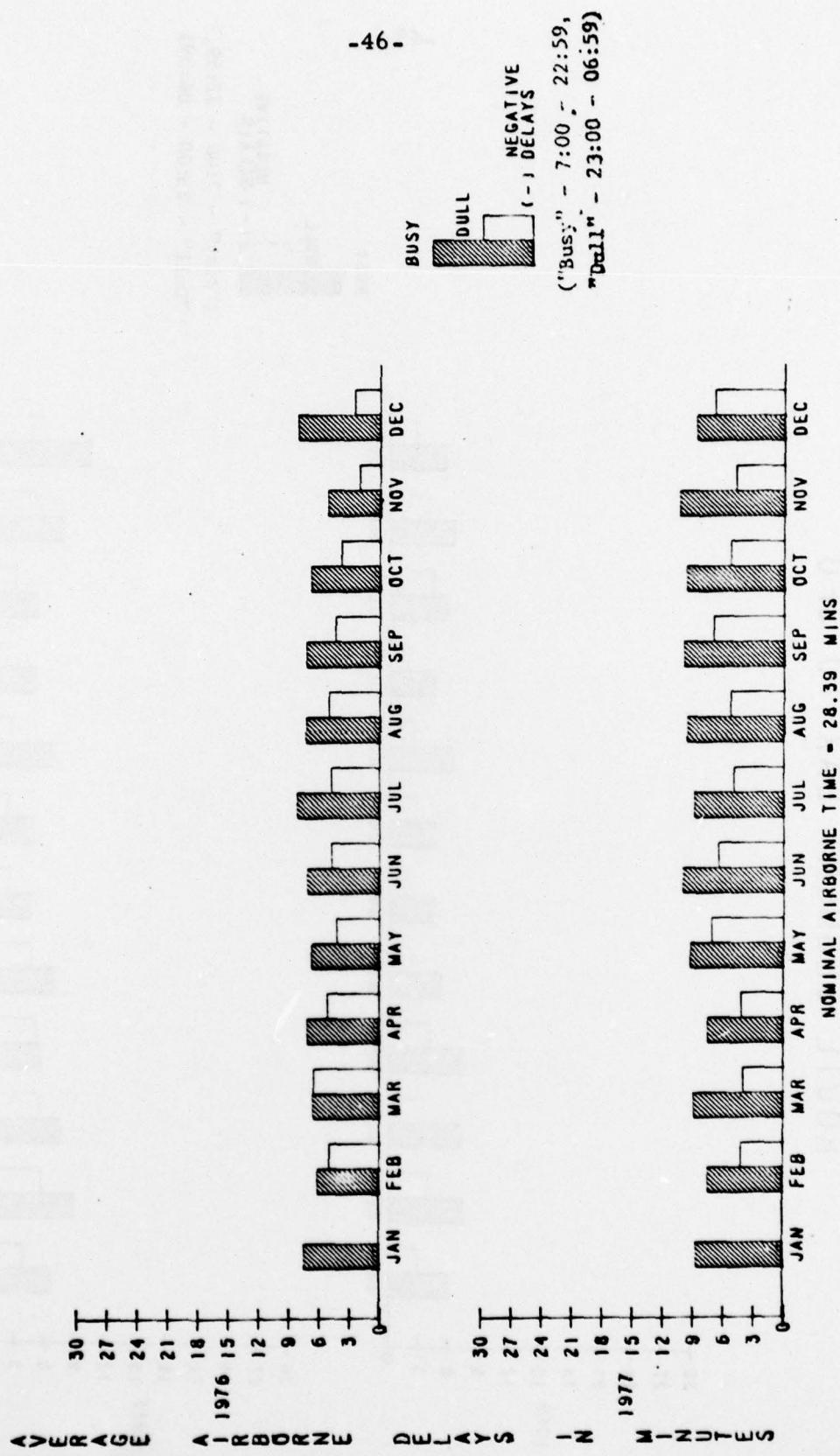


FIGURE 2.10

AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
 MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
 ROUTE SEGMENT ORD TO STL

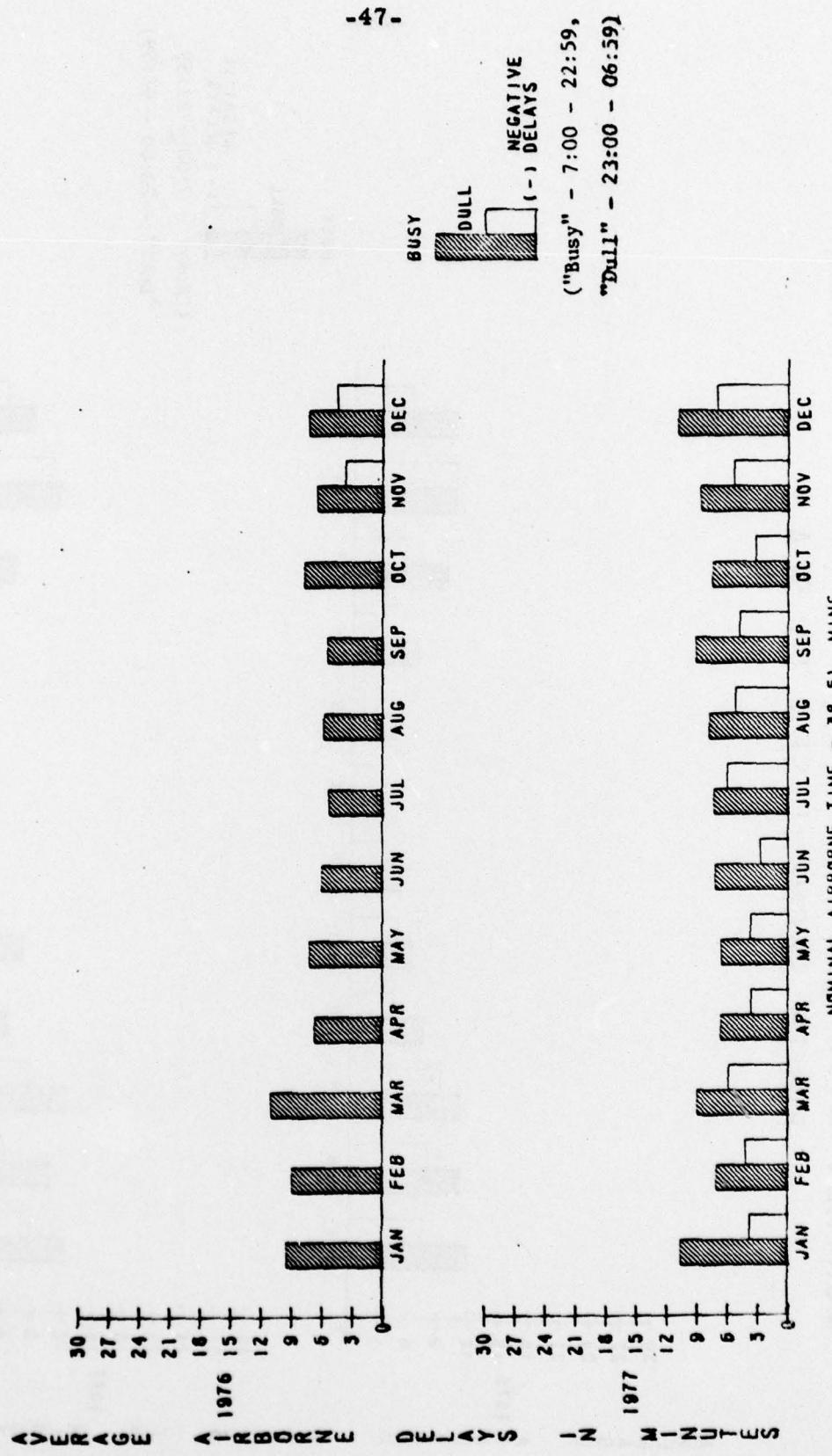


FIGURE 4.11

AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT SFO TO SEA

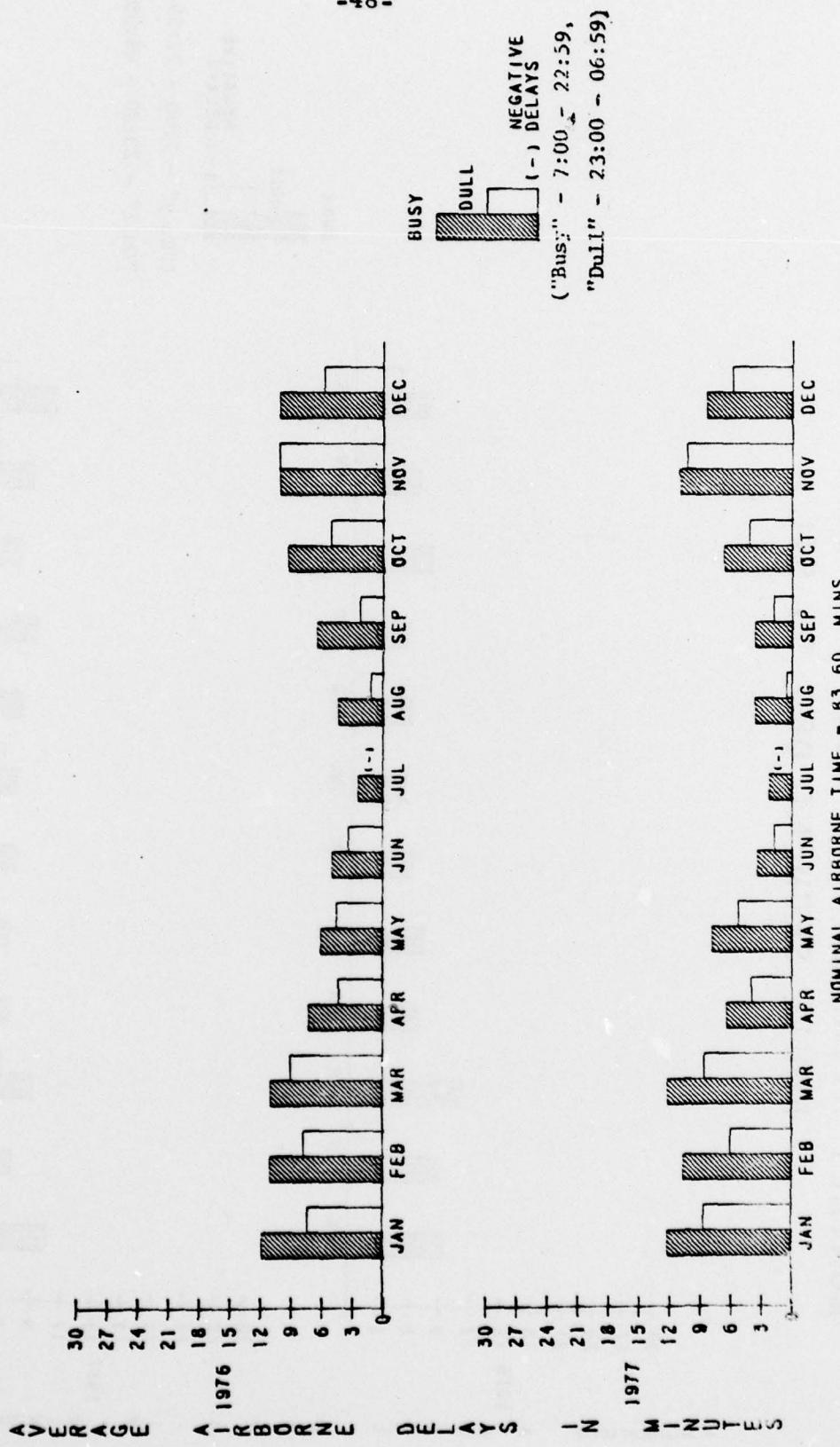


TABLE 4

AVERAGE MONTHLY AIRBORNE DELAYS FOR
ROUTE SEGMENTS TERMINATING AT ORD

<u>#FLIGHTS</u>	<u>AVG. AIRBORNE DELAY</u> (minutes)	<u>PEAK MONTH</u> (minutes)	<u>STD. DEVIATION</u> (minutes)
1972 106,613	0:11	Jan. 0:16	4.2
1973 105,827	0:13	Mar. 0:21	4.0
1974 85,704	0:17	Sept. 0:24	3.6
1975 103,090	0:14	Jan. 0:20	3.6
1976 101,528	0:13	Jan. 0:23	4.3
1977 103,941	0:12	Dec. 0:17	2.8